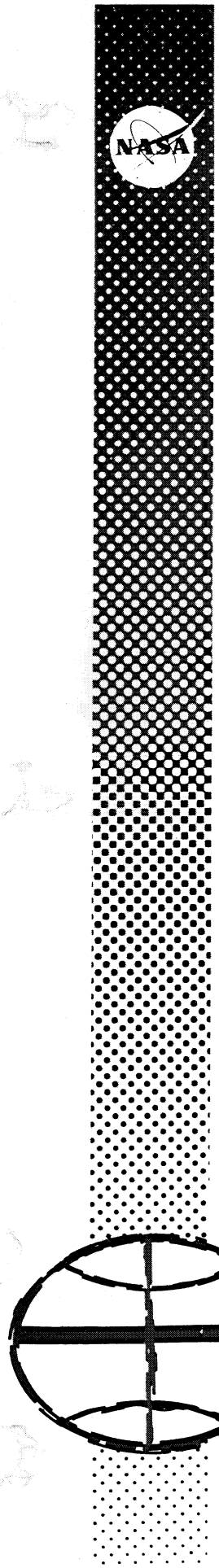

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

COMMAND/SERVICE MODULE SYSTEMS HANDBOOK

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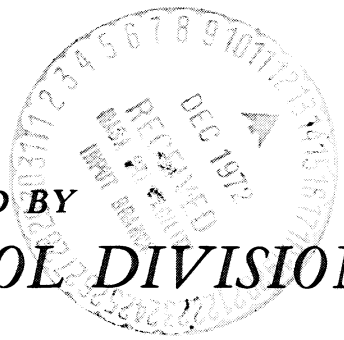
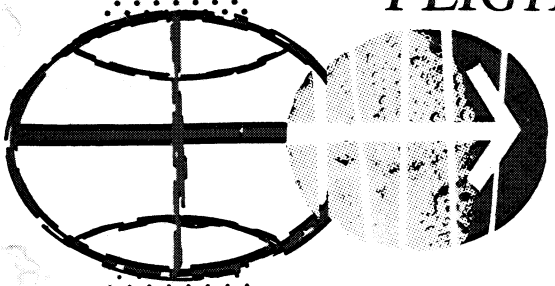
NOVEMBER 1, 1968



PREPARED BY

FLIGHT CONTROL DIVISION



MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

1 STANDARDS

2 SEQUENTIAL EVENTS SYSTEM

3 ELECTRICAL SYSTEM

4 ENVIRONMENTAL CONTROL SYS

5 FUEL CELL/ CRYOGENICS SYSTEM

6 COMMUNI- CATIONS SYSTEM

7 INSTRU- MENTATION

8 GUIDANCE AND CONTROL SYSTEM

9 SERVICE PROPULSION SYSTEM

10 REACTION CONTROL SYSTEM

11 MISCELLANEOUS

*

APOLLO

COMMAND/SERVICE MODULE SYSTEMS HANDBOOK

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PREFACE

This handbook, prepared by the Flight Control Division, NASA, Manned Spacecraft Center, Houston, Texas with technical support by North American Rockwell Corporation (NR), reflects the Command/Service Module (CSM 104) Spacecraft Systems as of November 1, 1968.

Major emphasis is on material for use by Flight Crew and Flight Controllers during mission operations. Caution should be exercised in using the systems drawings or other information in the handbook for any other purposes.

Comments concerning the contents of this handbook should be directed to FC36/Mr. Hubert V. Gregan, NR, Flight Operations Support, HU3-5805.

This document is not to be reproduced without written approval of the Chief, Flight Control Division, NASA, Manned Spacecraft Center, Houston, Texas.

Approved by:

Arnold D. Aldrich
Chief, CSM Systems Branch

Eugene F. Kranz
Acting Chief, Flight Control Division

CSM 10

*

FOREWORD

The basic Command/Service Module Systems Handbook (CSI being published and will be distributed in several installı

The publication control and effective page sheet imme following this foreword will serve as a table of contents lists by sections all figures, drawings, tables and pages that will be in the handbook whether they are included in issue or not.

The publication control and effective page sheet, whi continuously updated each time additional material is issu give a chronological history of the document and will show for which the information in each section is valid.

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COMMAND/SERVICE MODULE SYSTEMS HANDBOOK

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PCN REVISION INSTRUCTION SHEET

Update this document in accordance with the following instructions:

Remove and replace the following pages:

iia	vi	7-13	7-22
iii	vii	7-19	
iv	viii	7-20	
v	6-14	7-21	

Add the following new pages:

iib
ix

Make pen and ink changes to drawings and figures as follows:

NOTE: Each drawing and figure to be updated by pen and ink changes is listed below. Corrections to figures are indicated sequentially on their respective change instruction sheets and are referenced to the appropriate buses and circuit breakers. Drawing changes are indicated on IS and WAS sheets, and all change instruction sheets are collated in this PCN in the same sequence that the drawings and figures appear in the basic handbook. Changes to each drawing are shown by zones. Shading over portions of the IS drawings makes possible a rapid identification of items to be changed. Corrections need be made only where there is no shading. When the drawings and figures have been carefully updated, the pen and ink change instruction pages may be removed from this handbook.

Dwg 2.3	1 page of change instructions	Dwg 8.1	3 pages of change instructions
Dwg 2.7	3 pages of change instructions	Dwg 8.3	4 pages of change instructions
Dwg 3.1	1 page of change instructions	Dwg 8.4	1 page of change instructions
Fig 3.2	4 pages of change instructions	Dwg 8.5	4 pages of change instructions
Fig 3.3	1 page of change instructions	Dwg 8.6	2 pages of change instructions
Fig 3.4	1 page of change instructions	Dwg 8.7	1 page of change instructions
Dwg 4.1	2 pages of change instructions	Dwg 8.8A	1 page of change instructions
Dwg 4.2	2 pages of change instructions	Dwg 8.9A	2 pages of change instructions
Dwg 4.3	2 pages of change instructions	Dwg 8.9	2 pages of change instructions
Dwg 4.4	2 pages of change instructions	Dwg 8.10	1 page of change instructions
Dwg 4.5	2 pages of change instructions	Dwg 9.1	4 pages of change instructions
Dwg 6.1	1 page of change instructions	Dwg 9.2	1 page of change instructions
Dwg 6.3	1 page of change instructions	Dwg 10.1	1 page of change instructions
Dwg 6.6	1 page of change instructions	Dwg 10.2	1 page of change instructions
Dwg 7.2	1 page of change instructions	Dwg 11.3	1 page of change instructions
Dwg 7.3	1 page of change instructions		

PUBLICATION CONTROL AND EFFECTIVE PAGE SHEET

FIGURE, DRAWING OR PAGE NUMBER	TITLE	REVISION	SIGNOFF DATE
	SECTION 1 STANDARDS		
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	SECTION 2 SEQUENTIAL EVENTS SYSTEM		
FIGURE 2.1	CONTROL-DISPLAY FIGURE	BASIC	10/30/68
DRAWING 2.1	SEQUENTIAL OVERVIEW	BASIC	10/30/68
DRAWING 2.2	SEQUENTIAL POWER DISTRIBUTION	BASIC	10/30/68
DRAWING 2.3	SEQUENTIAL ABORT INITIATION (PEN AND INK CHANGES - 1 PAGE)	PCN-1	1/24/69
DRAWING 2.4	SEQUENTIAL LES AND SPS ABORT SUBSYSTEM	BASIC	10/30/68
DRAWING 2.5	SEQUENTIAL EARTH LANDING SUBSYSTEM	BASIC	10/30/68
DRAWING 2.6	SEQUENTIAL UPRIGHTING SYSTEM	BASIC	10/30/68
DRAWING 2.7	SEQUENTIAL LM SEPARATION AND DOCKING (PEN AND INK CHANGES - 3 PAGES)	PCN-1	1/24/69
DRAWING 2.8	CSM-LM ELECTRICAL INTERFACE	BASIC	10/30/68
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FIGURE 3.1	EPS CONTROL-DISPLAY FIGURE	BASIC	12/13/68
DRAWING 3.1	EPS OVERVIEW (PEN AND INK CHANGES - 1 PAGE)	PCN-1	1/24/69
DRAWING 3.2	ELECTRICAL DC DISTRIBUTION AND CONTROL SYSTEM AND RHEB 229 POWER DISTRIBUTION NOTES	BASIC	12/9/68

FIGURE, DRAWING OR PAGE NUMBER	TITLE	REVISION	SIGNOFF DATE
DRAWING 3.3	ELECTRICAL AC DISTRIBUTION AND CONTROL SYSTEM	BASIC	12/13/68
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	SECTION 4 ENVIRONMENTAL CONTROL SYSTEM		
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DRAWING 4.2	SUIT AND CABIN PRESSURIZATION (PEN AND INK CHANGES - 2 PAGES)	PCN-1	1/24/69
DRAWING 4.3	PRIMARY GLYCOL LOOP (PEN AND INK CHANGES - 2 PAGES)	PCN-1	1/24/69
DRAWING 4.4	SECONDARY GLYCOL LOOP (PEN AND INK CHANGES - 2 PAGES)	PCN-1	1/24/69
DRAWING 4.5	WATER AND WASTE MANAGEMENT (PEN AND INK CHANGES - 2 PAGES)	PCN-1	1/24/69
	SECTION 5 FUEL CELL/CRYOGENICS SYSTEM		
FIGURE 5.1	FUEL CELL/CRYOGENIC CONTROL-DISPLAY FIGURE	BASIC	10/28/68
DRAWING 5.1	FUEL CELL/CRYOGENIC OVERVIEW	BASIC	10/28/68
DRAWING 5.2	CRYOGENIC GAS STORAGE SYSTEM	BASIC	10/28/68
DRAWING 5.3	FUEL CELL	BASIC	11/1/68

FIGURE, DRAWING OR PAGE NUMBER	TITLE	REVISION	SIGNOFF DATE
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FIGURE 6.1	COMMUNICATIONS CONTROL-DISPLAY FIGURE	BASIC	10/10/68
DRAWING 6.1A	AUDIO STATION AND RF EQUIPMENT MODES AND CONTROL CHARTS	BASIC	10/10/68
DRAWING 6.1	COMMUNICATIONS OVERVIEW (PEN AND INK CHANGES - 1 PAGE)	PCN-1	1/24/69
DRAWING 6.2	UNIFIED S-BAND RF EQUIPMENT (PEN AND INK CHANGES - 1 PAGE)	PCN-1	1/24/69
DRAWING 6.3	VHF AM TRANSCEIVERS AND AUDIO EQUIPMENT	BASIC	10/10/68
DRAWING 6.4	PREMODULATION PROCESSOR (PEN AND INK CHANGES - 1 PAGE)	PCN-1	1/24/69
DRAWING 6.5	UPDATA LINK	BASIC	10/10/68
DRAWING 6.6	RENDEZVOUS TRANSPONDER AND RECOVERY EQUIPMENT (PEN AND INK CHANGES - 1 PAGE)	PCN-1	1/24/69
TABLE 6-I	UNIFIED S-BAND TRANSPONDER	BASIC	11/1/68
TABLE 6-II	S-BAND POWER AMPLIFIER	BASIC	11/1/68
TABLE 6-III	S-BAND DOWNLINK MODES AND MODULATION PROCESS	BASIC	11/1/68
TABLE 6-IV	S-BAND UPLINK MODES AND MODULATION PROCESS	PCN-1	1/24/69
TABLE 6-V	PREMODULATION PROCESSOR	BASIC	11/1/68
TABLE 6-VI	VHF AM TRANSCEIVER EQUIPMENT	BASIC	11/1/68
TABLE 6-VII	AUDIO CENTER EQUIPMENT	BASIC	11/1/68
TABLE 6-VIII	UPDATA LINK EQUIPMENT	BASIC	11/1/68
TABLE 6-IX	TELEVISION CAMERA, SLOW SCAN	BASIC	11/1/68
TABLE 6-X	RENDEZVOUS RADAR TRANSPONDER AND ANTENNA	BASIC	11/1/68
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FIGURE, DRAWING OR PAGE NUMBER	TITLE	REVISION	SIGNOFF DATE
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TABLE 6-XV	ANTENNA, S-BAND OMNI	BASIC	11/1/68
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TABLE 6-XVII	ANTENNA, VHF RECOVERY	BASIC	11/1/68
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DRAWING 7.1	INSTRUMENTATION POWER AND CONTROL	BASIC	10/10/68
DRAWING 7.2	INSTRUMENTATION PCM SIGNAL FLOW (PEN AND INK CHANGES - 1 PAGE)	PCN-1	1/24/69
DRAWING 7.3	CAUTION AND WARNING SYSTEM (PEN AND INK CHANGES - 1 PAGE)	PCN-1	1/24/69
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TABLE 7-II	PCM TELEMETRY-ELECTRICAL POWER SYSTEM	PCN-1	1/24/69
TABLE 7-III	PCM TELEMETRY-LAUNCH ESCAPE SYSTEM	BASIC	11/1/68
TABLE 7-IV	PCM TELEMETRY-EARTH LANDING SEQUENCE CONTROLLER	BASIC	11/1/68
TABLE 7-V	PCM TELEMETRY-ENVIRONMENTAL CONTROL SYSTEM	PCN-1	1/24/69
TABLE 7-VI	PCM TELEMETRY-GUIDANCE AND NAVIGATION SYSTEM	PCN-1	1/24/69
TABLE 7-VII	PCM TELEMETRY-STABILIZATION AND CONTROL SYSTEM	PCN-1	1/24/69

FIGURE, DRAWING OR PAGE NUMBER	TITLE	REVISION	SIGNOFF DATE
TABLE 7-VIII	PCM TELEMETRY-LIFE SYSTEM	BASIC	11/1/68
TABLE 7-IX	PCM TELEMETRY-FLIGHT TECHNOLOGY	BASIC	11/1/68
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TABLE 7-XI	PCM TELEMETRY-SERVICE PROPULSION SYSTEM	BASIC	11/1/68
TABLE 7-XII	PCM TELEMETRY-REACTION CONTROL SYSTEM	BASIC	11/1/68
TABLE 7-XIII	PCM TELEMETRY-CREW SAFETY SYSTEM	BASIC	11/1/68
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FIGURE 8.1	GUIDANCE AND CONTROL SYSTEM CONTROL-DISPLAY FIGURE	103/104	12/13/68
DRAWING 8.1	GUIDANCE AND NAVIGATION OVERVIEW (PEN AND INK CHANGES - 3 PAGES)	PCN-1	1/24/69
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FIGURE, DRAWING OR PAGE NUMBER	TITLE	REVISION	SIGNOFF DATE
PAGE 8-74	ENTRY AND UPDATE	BASIC	11/1/68
DRAWING 8.4	G&N POWER DISTRIBUTION (PEN AND INK CHANGES - 1 PAGE)	PCN-1	1/24/69
DRAWING 8.5	INERTIAL SUBSYSTEM (PEN AND INK CHANGES - 4 PAGES)	PCN-1	1/24/69
DRAWING 8.6	OPTICS SUBSYSTEM (PEN AND INK CHANGES - 2 PAGES)	PCN-1	1/24/69
DRAWING 8.7	SCS POWER DISTRIBUTION (PEN AND INK CHANGES - 1 PAGE)	PCN-1	1/24/69
DRAWING 8.8A	ATTITUDE REFERENCE LOGIC (PEN AND INK CHANGES - 1 PAGE)	PCN-1	1/24/69
DRAWING 8.8	ATTITUDE REFERENCE SUBSYSTEM	BASIC	10/31/68
DRAWING 8.9A	CONTROL ELECTRONICS LOGIC (PEN AND INK CHANGES - 2 PAGES)	PCN-1	1/24/69
DRAWING 8.9	CONTROL ELECTRONICS (ECA/ TVC/GYROS) (PEN AND INK CHANGES - 2 PAGES)	PCN-1	1/24/69
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DRAWING 9.1	SERVICE PROPULSION SYSTEM (PEN AND INK CHANGES - 4 PAGES)	PCN-1	1/24/69
DRAWING 9.2	SPS PROPELLANT GAUGING SYSTEM (PEN AND INK CHANGES - 1 PAGE)	PCN-1	1/24/69
DRAWING 9.3	SPS PROPELLANT UTILIZATION VALVE CONTROL	BASIC	10/27/68
	SECTION 10 REACTION CONTROL SYSTEM		
FIGURE 10.1	RCS CONTROL-DISPLAY FIGURE	BASIC	10/27/68
DRAWING 10.1	SERVICE MODULE REACTION CONTROL SYSTEM (PEN AND INK CHANGES - 1 PAGE)	PCN-1	1/24/69

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FIGURE, DRAWING OR PAGE NUMBER	TITLE	REVISION	SIGNOFF DATE
DRAWING 10.2	COMMAND MODULE REACTION CONTROL SYSTEM (PEN AND INK CHANGES - 1 PAGE)	PCN-1	1/24/69
	SECTION 11 MISCELLANEOUS		
FIGURE 11.1A	CONTROL-DISPLAY FIGURE	N/A*	
FIGURE 11.1	CONTROL-DISPLAY FIGURE	N/A*	
DRAWING 11.1.1 THROUGH DRAWING 11.1.9	NR INBOARD PROFILE DRAWINGS	N/A*	
DRAWING 11.2	LIGHTING	BASIC	11/1/68
DRAWING 11.3	TIMER (PEN AND INK CHANGES - 1 PAGE)	PCN-1	1/24/69
DRAWING 11.4	SYSTEMS TESTMETER	BASIC	11/1/68

*NR DRAWINGS, NOT OFFICIAL FCD DRAWINGS.

1 STANDARDS

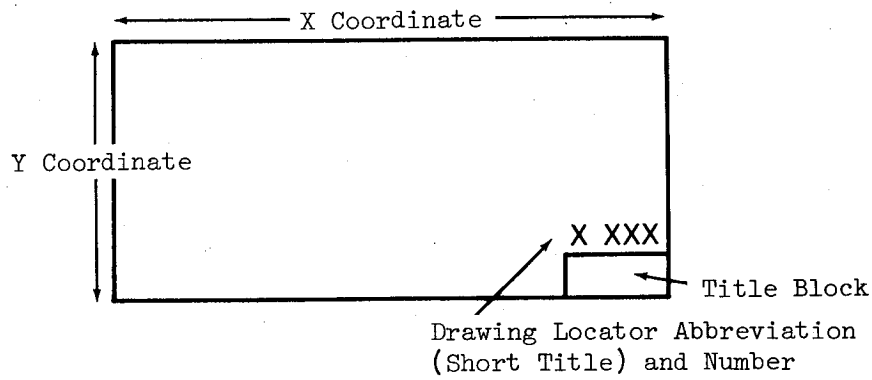
STANDARDS

1.1 GENERAL DRAWING INFORMATION

1.1.1 Cross-indexing

1.1.1.1 General drawing configuration

The X coordinate zones are marked alphabetically from the right-hand edge of the sheet (including the 1/2 inch margin). The Y coordinate zones are marked numerically from the bottom right-hand and left-hand corners of the sheet.



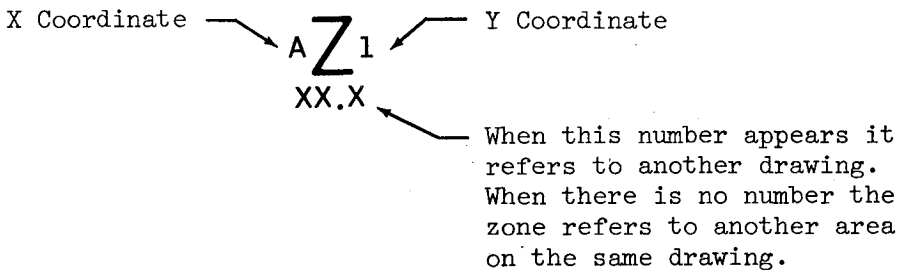
1.1.1.2 Component location code

The component location code is used to reference controls (on the control-display figure) and components (on the overview drawing) into the detail system drawings.

3 - Drawing Locator Number for the given detail subsystem drawing
K - X Coordinate
4 - Y Coordinate

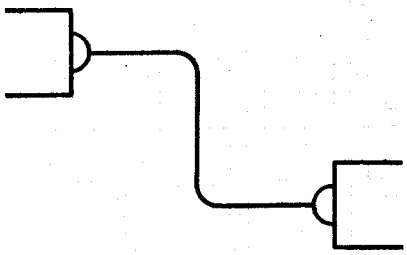
1.2.1 Technical Zone References

1.2.1.1 Zone reference



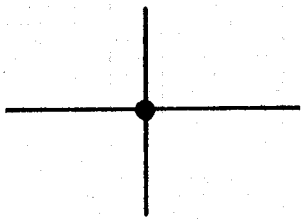
1.2 LINE LEGEND

1.2.1 RF Cable

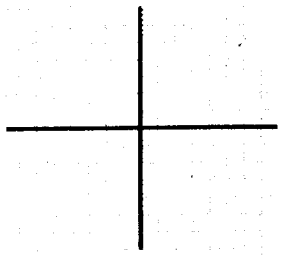


1.2.2 Electrical Line, Power and control

1.2.2.1 Electrical connected

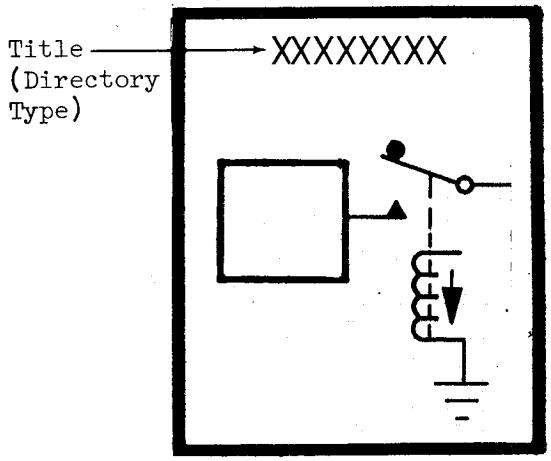


1.2.2.2 Electrical crossover



1.2.3 Directional Flow Arrows

1.2.4 Component Enclosures



1.2.4.1 Main enclosure
1/16-inch solid
black line

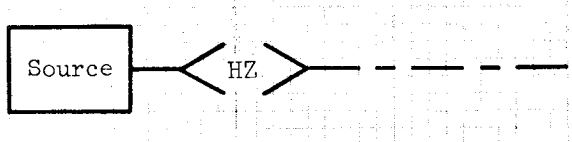
1.2.4.2 Sub enclosure
1/32-inch solid
black line

1.2.4.3 Component enclosure with crew (manual control)
1/16-inch dashed
black line

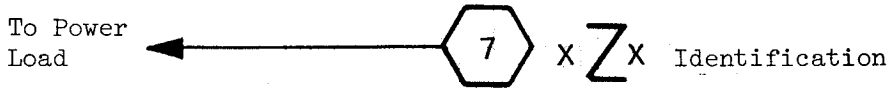
1.2.4.4 Module interface and systems assembly
1/8-inch dashed
black line

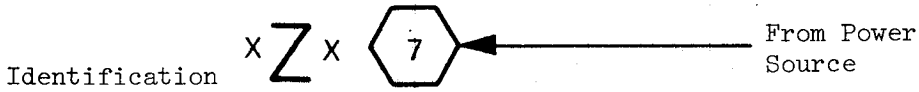
1.2.5 Mechanical Linkage

1.2.6 Timing Pulses

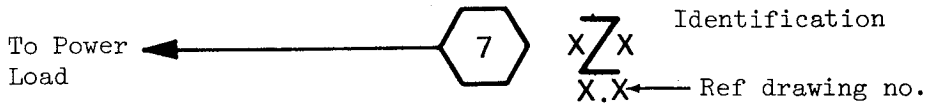


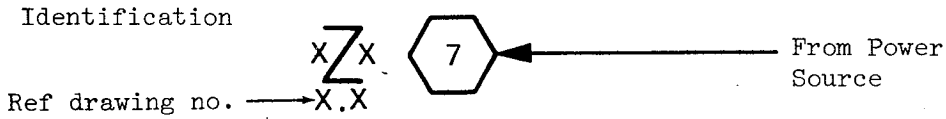
1.2.1.2 Power intra-drawing
(Section to section within the same drawing)





1.2.1.3 Power inter-drawings
(Drawing to drawing)

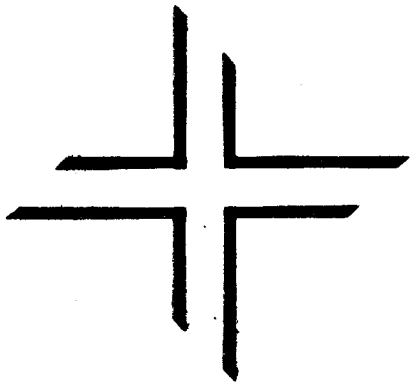




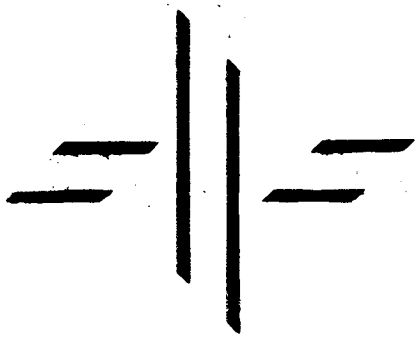
1.3 PIPE LEGEND

1.3.1 General

1.3.1.1 Plumbing connected

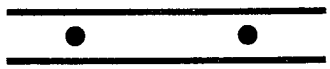


1.3.1.2 Plumbing crossover



1.3.2 Line Designation

1.3.2.1 Water



1.3.2.2 Oxygen

1.3.2.3 Nitrogen

1.3.2.4 Helium

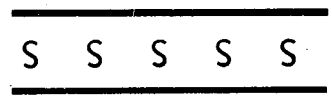
1.3.2.5 Primary Coolant

1.3.2.6 Secondary Coolant

1.3.2.7 Fuel

1.3.2.8 Hydrogen

1.3.2.9 Steam

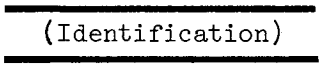


1.3.2.10 Suit Loop

1.3.2.11 Sense Lines

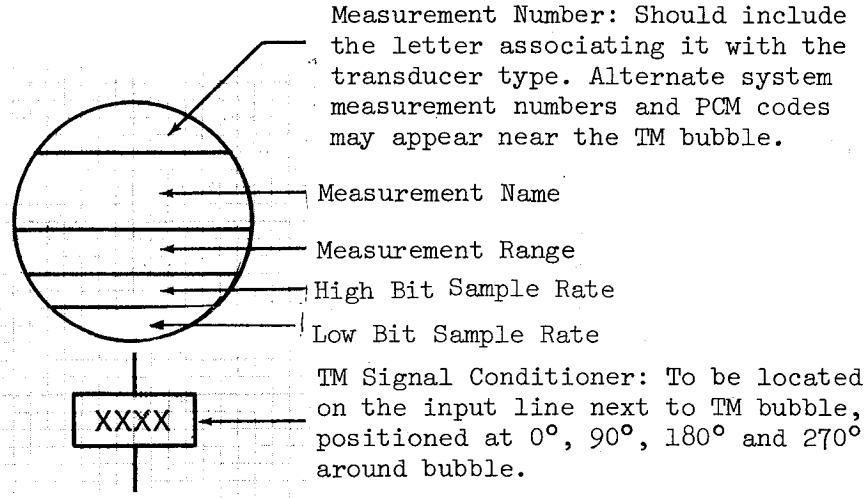
1.3.2.12 Oxidizer

1.3.2.13 Others

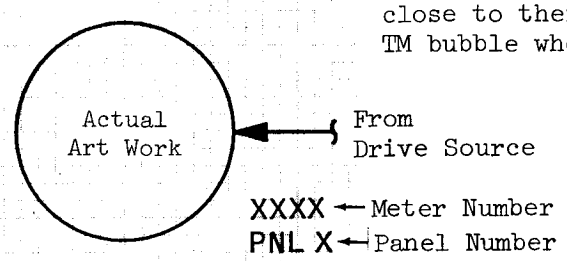


1.4 TELEMETRY SYMBOLS

1.4.1 Measurements Telemetered

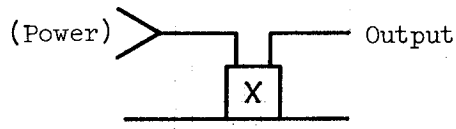


1.4.2 Onboard Meters



1.4.3 Sensors

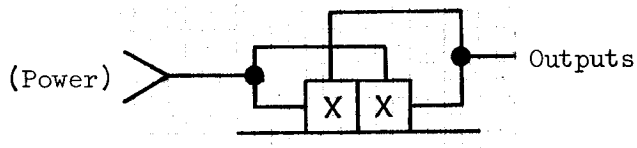
1.4.3.1 Single source



Example: Letter indicates the type:

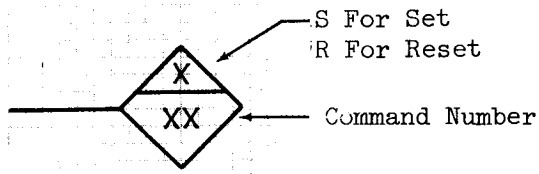
P - Pressure
T - Temperature
Q - Quantity
W - Wetness
R - Rate

1.4.3.2 Double source



1.4.4 Ground Commands (Contents Optional by Vehicle)

1.4.4.1 RTC's



1.5 ELECTRICAL SYMBOLS

1.5.1 Switches

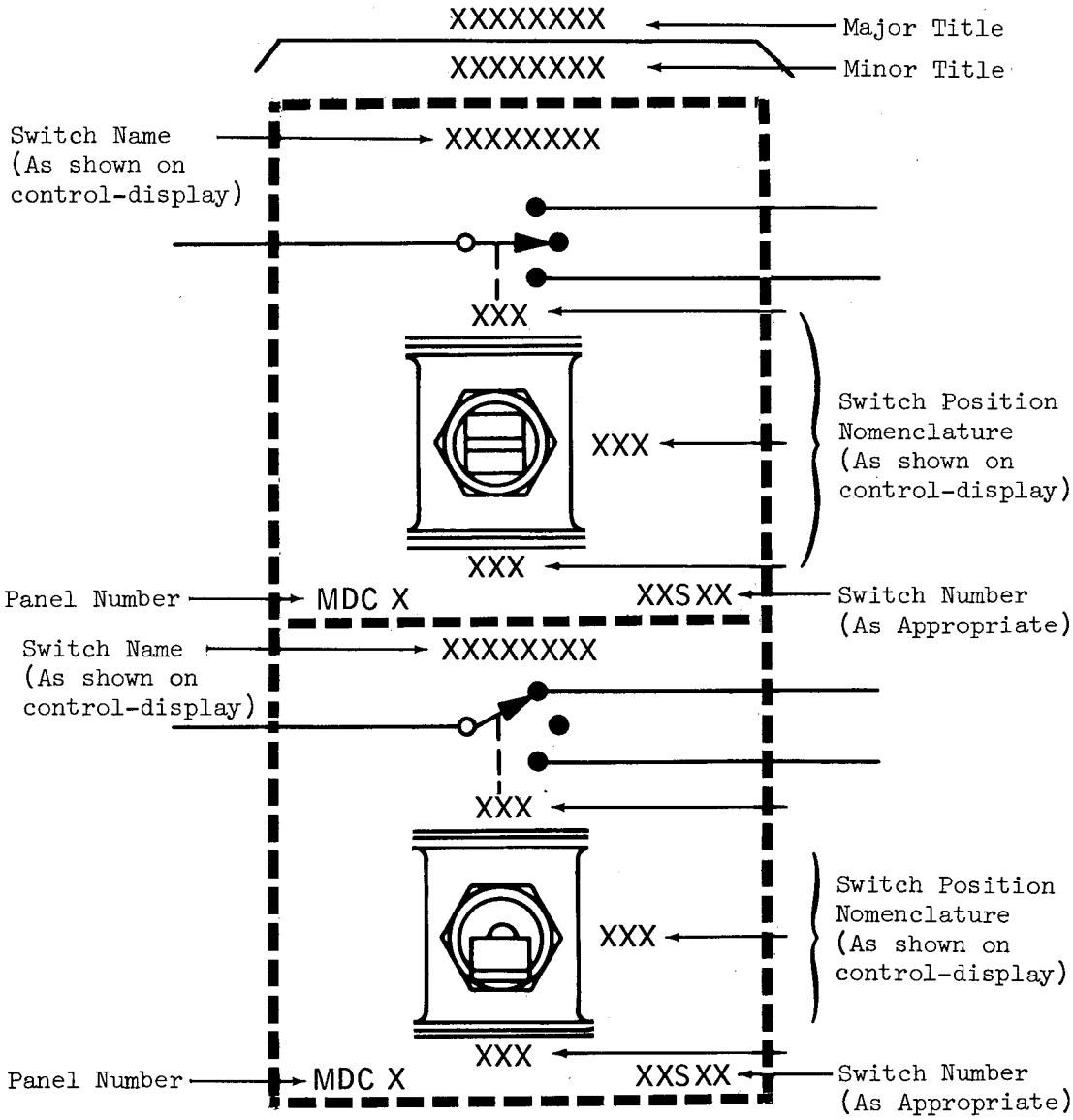
All switches will be shown in the deenergized position (if possible). When a switch has more than one set of contacts, only one set needs to have switch contact nomenclature.

1.5.1.1 Switch nomenclature

Major Title: The title given to a group of switches on the panel.

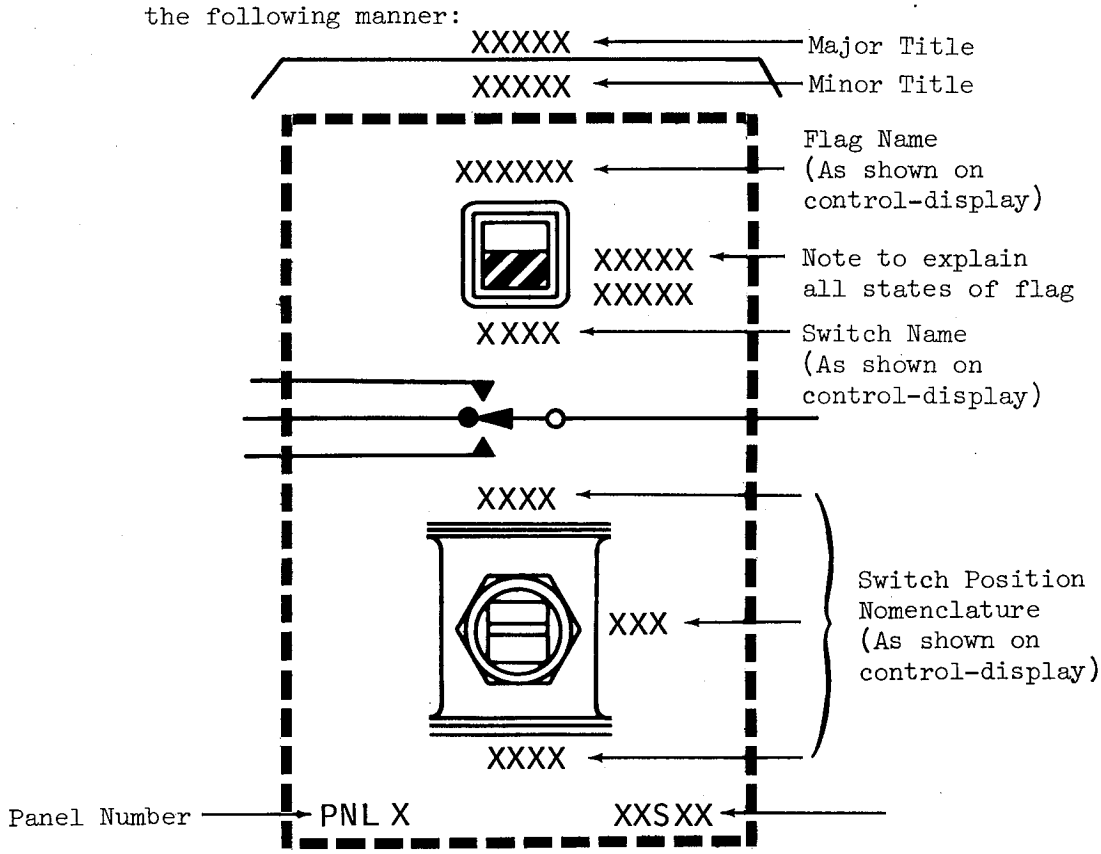
Minor Title: The title given to a sub-group of switches

NOTE: If more than one switch has identical major and minor titles, they may be stacked without repeating these titles.

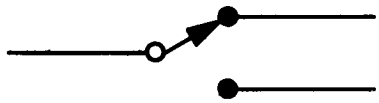


1.5.1.2 Switch controlled flag

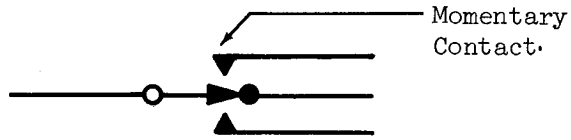
If a flag is directly controlled by a switch, it may be shown in the following manner:



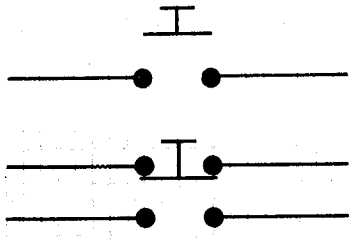
1.5.1.3 Two-position



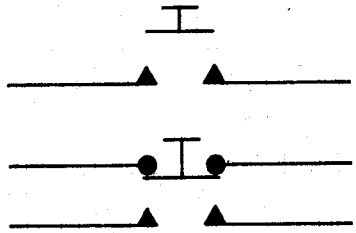
1.5.1.4 Three-position



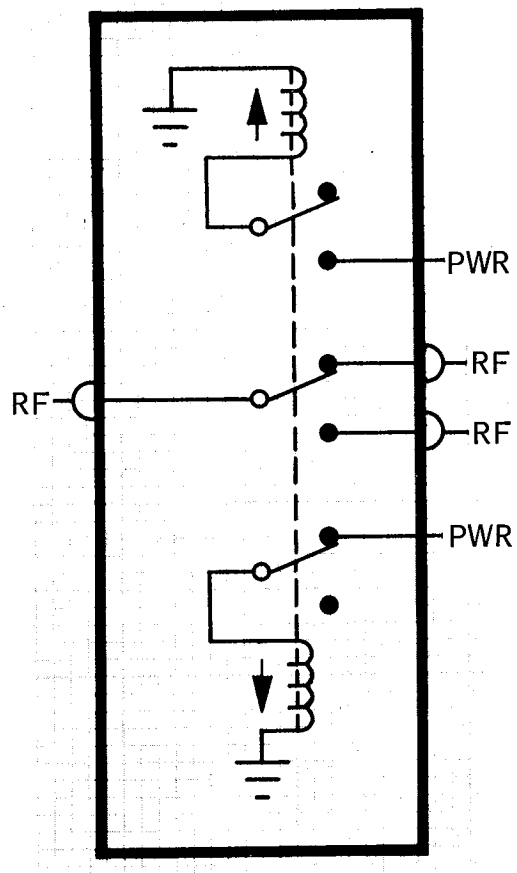
1.5.1.5 Pushbutton
1.5.1.5.1 Latching



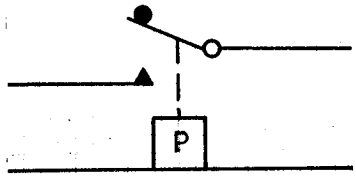
1.5.1.5.2 Momentary



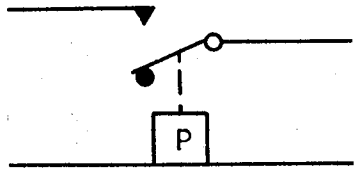
1.5.1.6 Coax



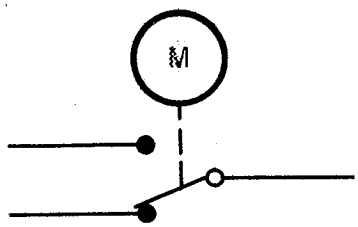
1.5.1.7 Pressure
1.5.1.7.1 Closed decreased pressure



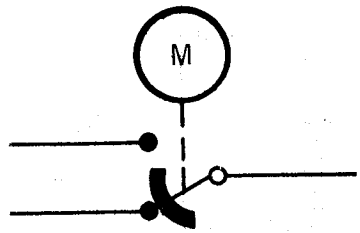
1.5.1.7.2 Closed increased pressure



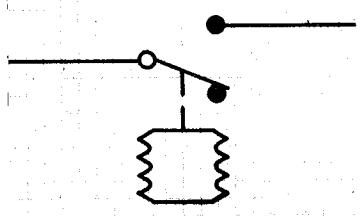
1.5.1.8 Motor
1.5.1.8.1 Break before make



1.5.1.8.2 Made before break



1.5.1.9 Baro

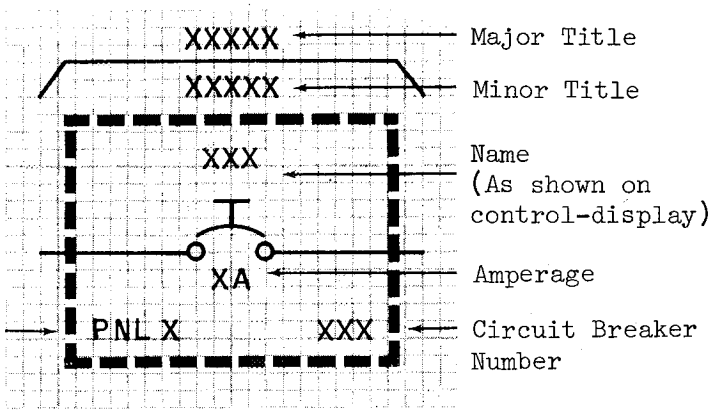


Close XXX psi or altitude
Open XXX psi or altitude

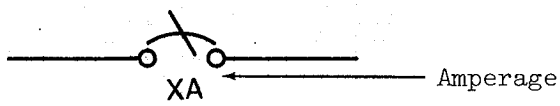
1.5.2 Circuit Breakers

The circuit breaker should be placed near the associated bus whenever possible. For the difference between major and minor titles see remark under switches (1.5.1.1).

1.5.2.1 Pushbutton

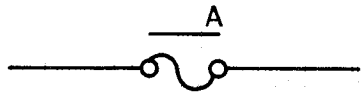


1.5.2.2 Automatic



1.5.3 Fuses

1.5.3.1 General

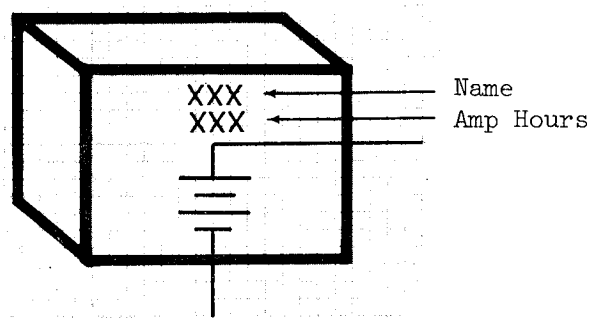


1.5.3.2 Fusistor

1.5.4 Battery

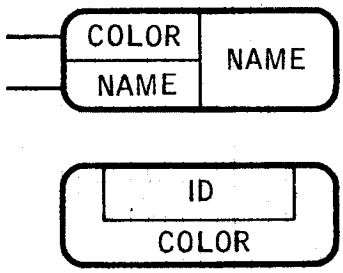
1/16-inch black tape

Size varies with number of cells and drawing arrangement.

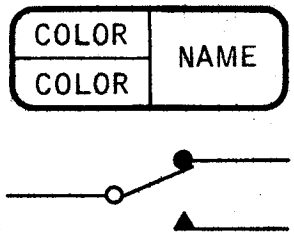


1.5.5 Lights

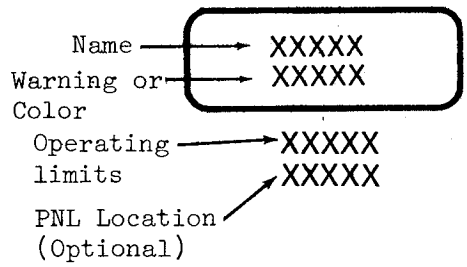
1.5.5.1 Telelights



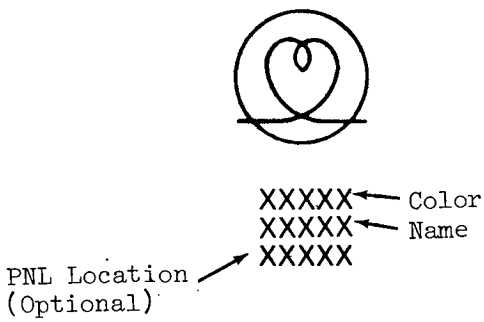
1.5.5.2 Switching



1.5.5.3 Caution and warning

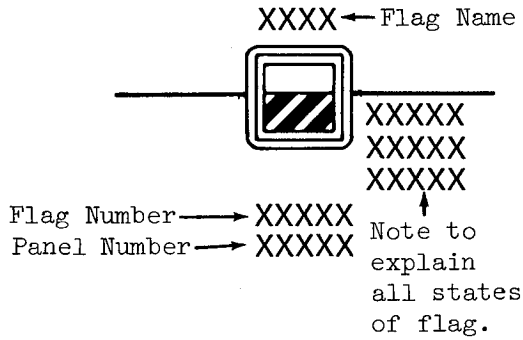


1.5.5.4 Component



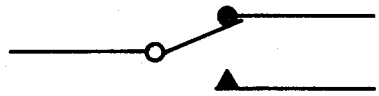
1.5.6 Annunciator Flag

Flag symbol will not reflect switch position of the associated switch.

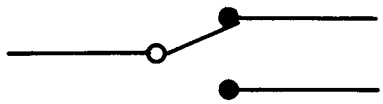


1.5.7 Relays

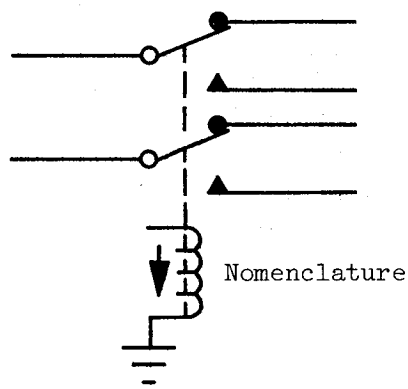
1.5.7.1 Momentary contact



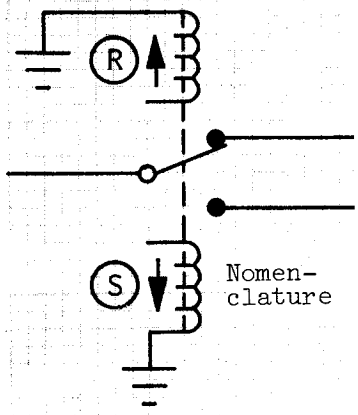
1.5.7.2 Latching contacts



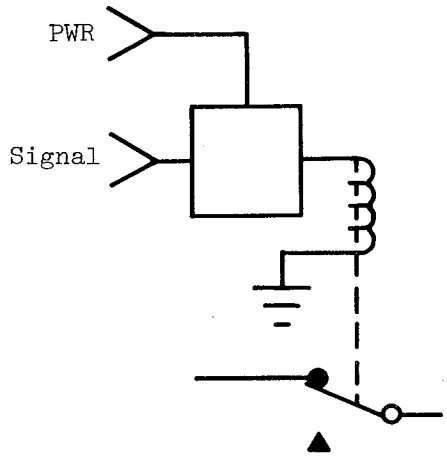
1.5.7.3 Non-latching relay



1.5.7.4 Latching relay

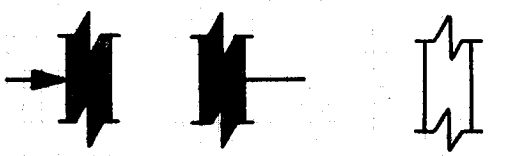


1.5.8 Relay or Solenoid Driver



1.5.9 Buses
1.5.9.1 Symbol

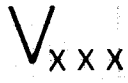
Length can vary depending on the bus function on a given drawing.



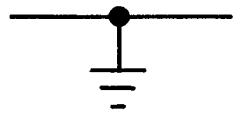
Bus Feed Bus Output Neg Bus

1.5.9.2 Designation

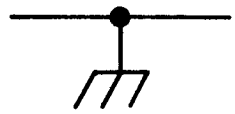
See bus designation list.



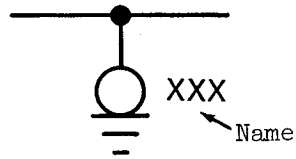
1.5.10 Grounds
1.5.10.1 System



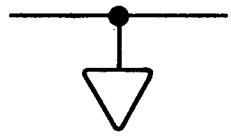
1.5.10 Frame



1.5.10.3 Floating or Controlled



1.5.10.4 Signal



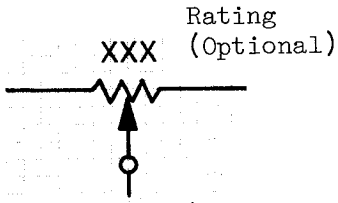
1.5.11 Diodes
1.5.11.1 General

1.5.11.2 Zener

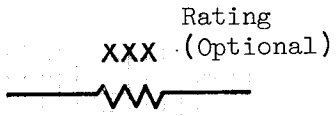
1.5.11.3 Tunnel

1.5.11.4 Control rectifier (SCR)

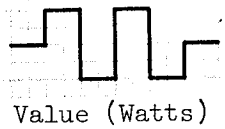
1.5.12 Potentiometer



1.5.13 Fixed Resistor



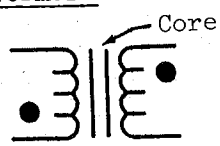
1.5.14 Heater



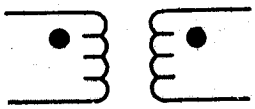
1.5.15 Thermostat

1.5.16 Transformers

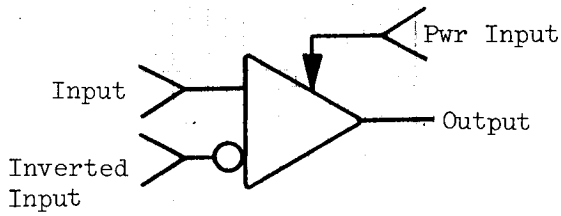
Polarity dots indicate out phase



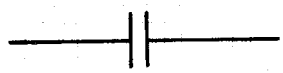
Polarity dots indicate in phase



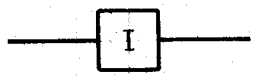
1.5.17 Amplifier



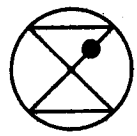
1.5.18 Capacitor



1.5.19 Digital Inverter



1.5.20 Wire Resolver

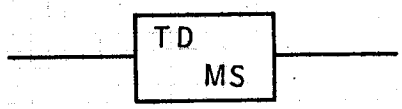


= Sine Winding

= Minus Sine

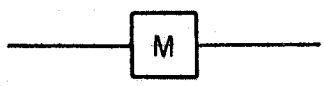
= Cosine Winding

1.5.21 Time Delay



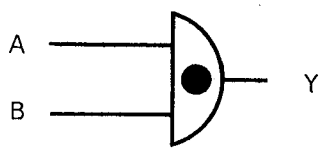
1.5.22 Electrical Filter

1.5.23 Modulator

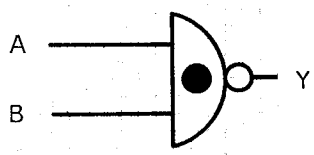


1.5.24 Gates

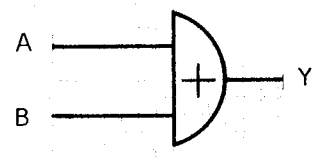
1.5.24.1 And



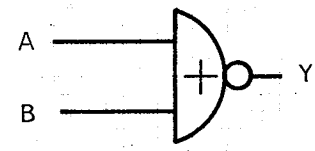
1.5.24.2 Nand



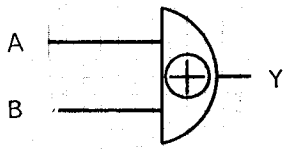
1.5.24.3 Or



1.5.24.4 Nor



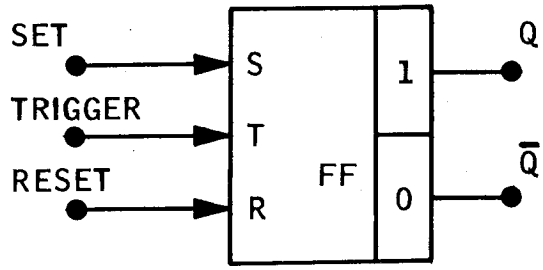
1.5.24.5 Exclusive Or



A	B	Y
1	1	1
1	0	0
0	1	0
0	0	0
1	1	0
1	0	1
0	1	1
0	0	1
1	1	1
1	0	1
0	1	1
0	0	0
1	0	0
0	1	0
1	0	0
0	0	0
1	1	0
1	0	1
0	1	1
0	0	0

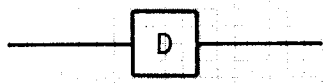
Open circle means it is an inverter and may appear on any of the lines on the gate.

1.5.24.6 SRT Flip-Flop

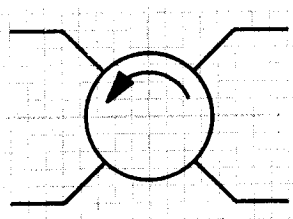


INPUT	OUTPUT
S	Sets Q to A "1" Sets $\bar{Q}$ to A "0"
T	Q and $\bar{Q}$ Change States
R	Resets Q to A "0" Resets $\bar{Q}$ to A "1"

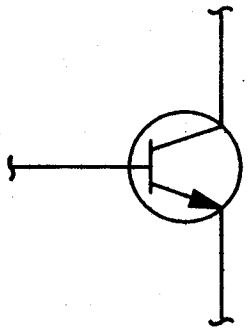
1.5.25 Demodulator



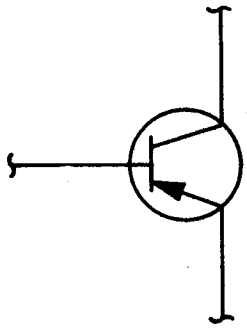
1.5.26 RF Circulator



1.5.27 Transistor
1.5.27.1 NPN

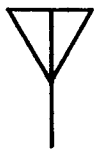


1.5.27.2 PNP



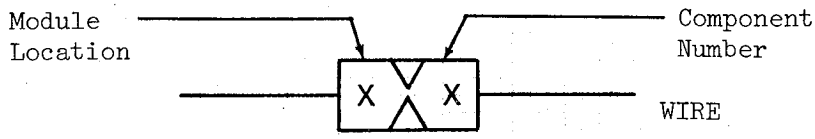
1.5.28 Antenna

Name
(Type or Function)

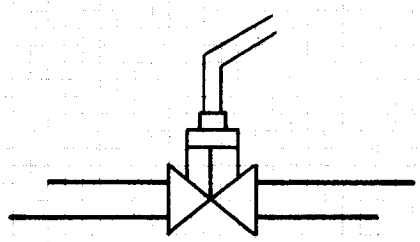


1.6 PYROTECHNIC SYMBOLS

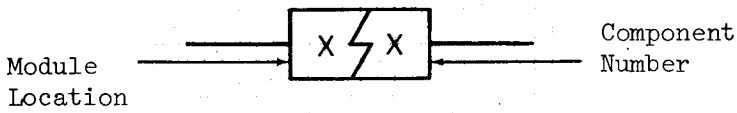
1.6.1 Pyro Guillotine



1.6.2 Pyro Valve with Single Initiator

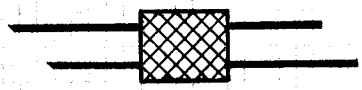


1.6.3 Electrical Circuit Interrupter

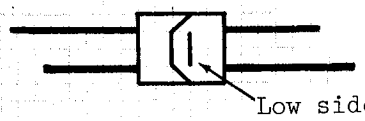


1.7 MECHANICAL SYMBOLS

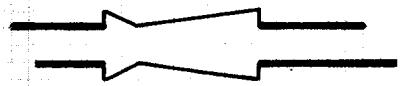
1.7.1 Mechanical Filter



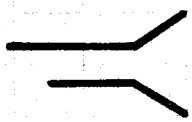
1.7.2 Burst Diaphragm



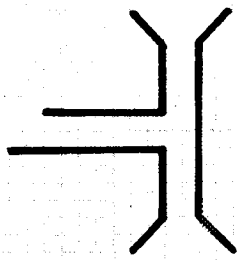
1.7.3 Venturi



1.7.4 Vent



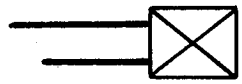
1.7.5 Thrust Neutralized Vent



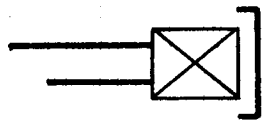
1.7.6 Disconnects

1.7.6.1 Self-sealing

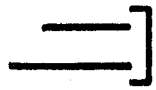
1.7.6.2 Quick



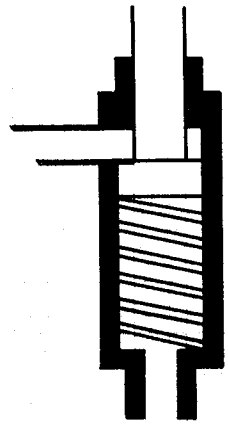
1.7.7 Quick Disconnect Fill and Drain



1.7.8 Fill and Drain



1.7.9 Ball Valve Actuator

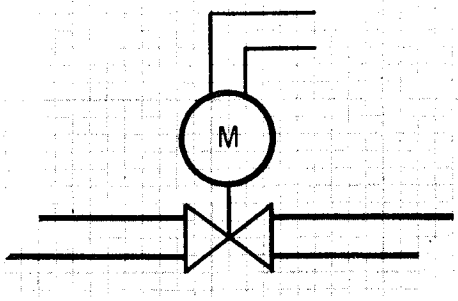


May be shown in depressed or partially depressed position

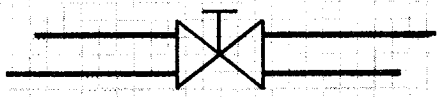
1.7.10 Valves

Open

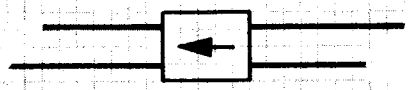
1.7.10.1 Motor control



1.7.10.2 Manual control



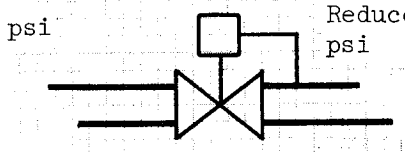
1.7.10.3 Check valve



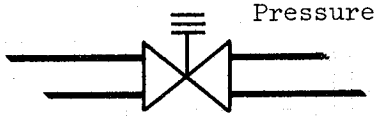
1.7.10.4 Orifice

(Flow Rate)

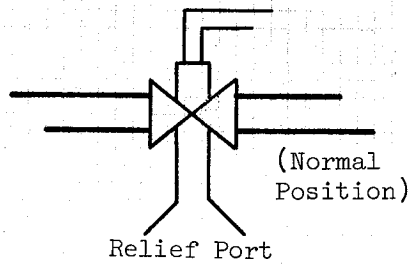
1.7.10.5 Pressure regulator



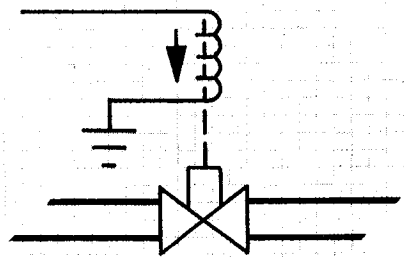
1.7.10.6 Relief valve



1.7.10.7 Pneumatic controlled valve with line bleed



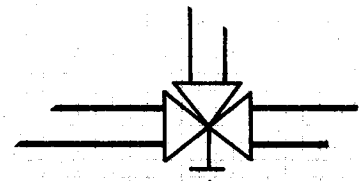
1.7.10.8 Solenoid valve



Name (Normal Position)

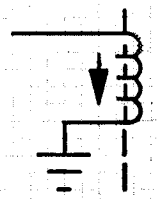
1.7.10.9 Three-way valve

1.7.10.9.1 Manual



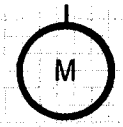
1.7.10.9.2 Solenoid

OR

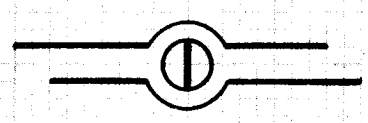


OR

1.7.10.9.3 Motor controlled



1.7.10.10 Ball valve

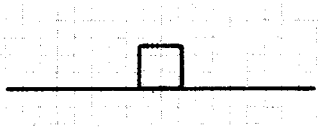


1.8 MISCELLANEOUS SYMBOLS

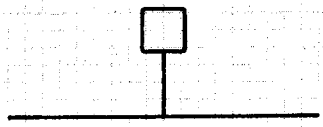
1.8.1 Drawing Note Reference

1.8.2 Overview Drawing Instrumentation Legend

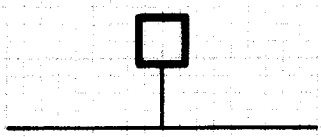
1.8.2.1 Automatic control only



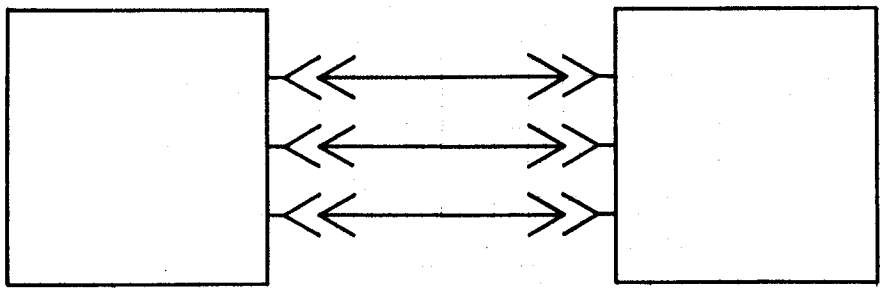
1.8.2.2 PCM only



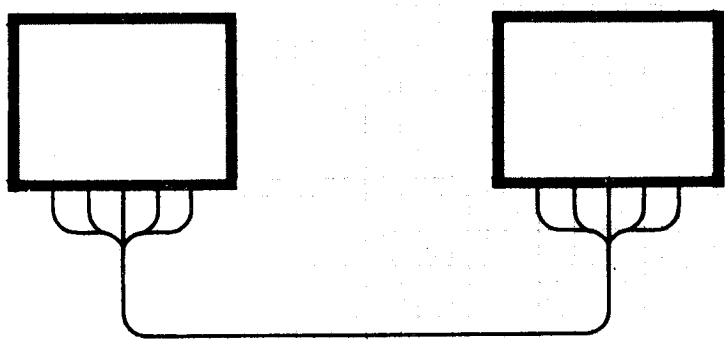
1.8.2.3 PCM and/or onboard display



1.8.3 Two-unit Interface



1.8.4 Two-unit Cable Connection



1.8.5 BUSSES

1.8.5.1 POWER BUSSES

- V_{MA} - MAIN BUS A
- V_{MB} - MAIN BUS B
- V_{BA} - BATTERY BUS A
- V_{BB} - BATTERY BUS B
- V_{BR} - BATTERY RELAY BUS
- V_{FP} - FLIGHT AND POSTLANDING BUS
- V_{NE1} - NON-ESSENTIAL BUS 1
- V_{NE2} - NON-ESSENTIAL BUS 2
- V_{AC1} - AC BUS 1
- V_{AC2} - AC BUS 2
- V_{F} - FLIGHT BUS
- V_{SMA} - SERVICE MODULE BUS A
- V_{SMB} - SERVICE MODULE BUS B

1.8.5.2 SEQUENTIAL BUSSES

V_{SQA} - SEQUENTIAL PYRO BUS A

V_{RQA} - RCS CONTROLLER PYRO BUS A

V_{RLA} - RCS CONTROLLER LOGIC BUS A

V_{LQA} - LM DOCKING BUS A

V_{SLA} - SEQUENTIAL LOGIC BUS A

V_{SAA} - SEQUENTIAL ARM BUS A

V_{ELA} - EARTH LANDING BUS A

V_{SQB} - SEQUENTIAL PYRO BUS B

V_{RQB} - RCS CONTROLLER PYRO BUS B

V_{RLB} - RCS CONTROLLER LOGIC BUS B

V_{LQB} - LM DOCKING BUS B

V_{SLB} - SEQUENTIAL LOGIC BUS B

V_{SAB} - SEQUENTIAL ARM BUS B

V_{ELB} - EARTH LANDING BUS B

SEQUENTIAL BUSSES (cont'd)

V_{ED1} - EMERGENCY DETECTION SYSTEM BUS NO. 1

V_{ED2} - EMERGENCY DETECTION SYSTEM BUS NO. 2

V_{ED3} - EMERGENCY DETECTION SYSTEM BUS NO. 3

V_{6D95} - IU ABORT BUS

1.8.5.3 INSTRUMENTATION BUSSES

V_{1} - CM ESS INST BUS PWR FROM RHEB PNL 276-CB1

V_{2} - CM ESS INST BUS PWR FROM RHEB PNL 276-CB2

V_{3S} - SM ESS INST BUS PWR FROM RHEB PNL 276-CB3

V_{4S} - SM ESS INST BUS PWR FROM RHEB PNL 276-CB4

V_{5} - CM NON ESS INST BUS PWR FROM RHEB PNL 277-CB5

V_{6} - CM NON ESS INST BUS PWR FROM RHEB PNL 277-CB6

V_{7} - CM NON ESS INST BUS PWR FROM RHEB PNL 277-CB7

V_{8} - CM NON ESS INST BUS PWR FROM RHEB PNL 277-CB8

V_{8S} - SM NON ESS INST BUS PWR FROM RHEB PNL 277-CB8

INSTRUMENTATION BUSSES (Cont'd)

V_9 - CM NON ESS INST BUS PWR FROM RHEB PNL 277-CB9

V_{10} - CM NON ESS INST BUS PWR FROM RHEB PNL 277-CB10

V_{SC} - SCE PWR REQ'D FOR SIGNAL CONDITIONING (+20, -20, and/or +10Vdc)

V_{SC5} - SCE CM +5Vdc PWR

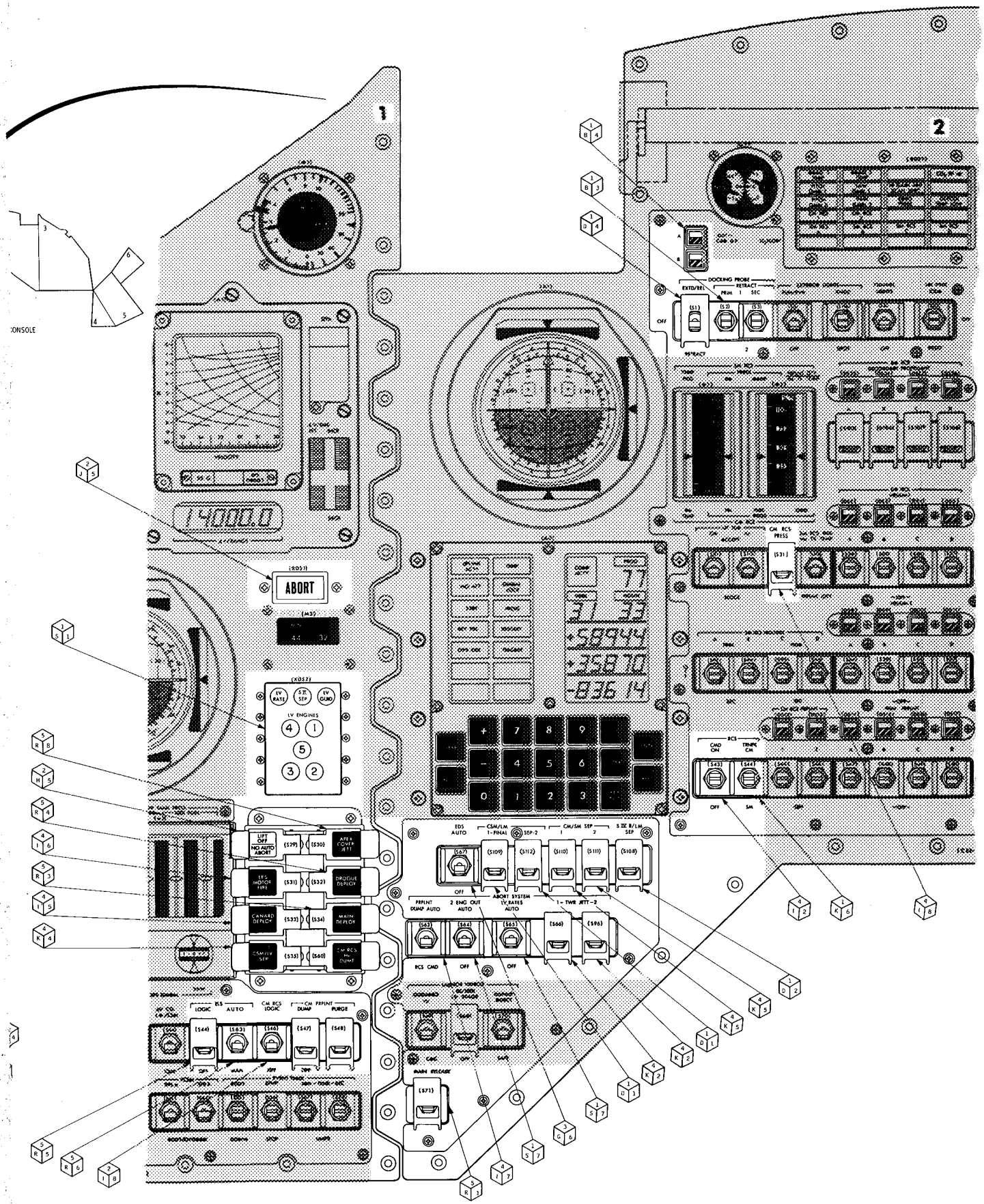
1.8.5.4 SCS LOGIC BUSSES

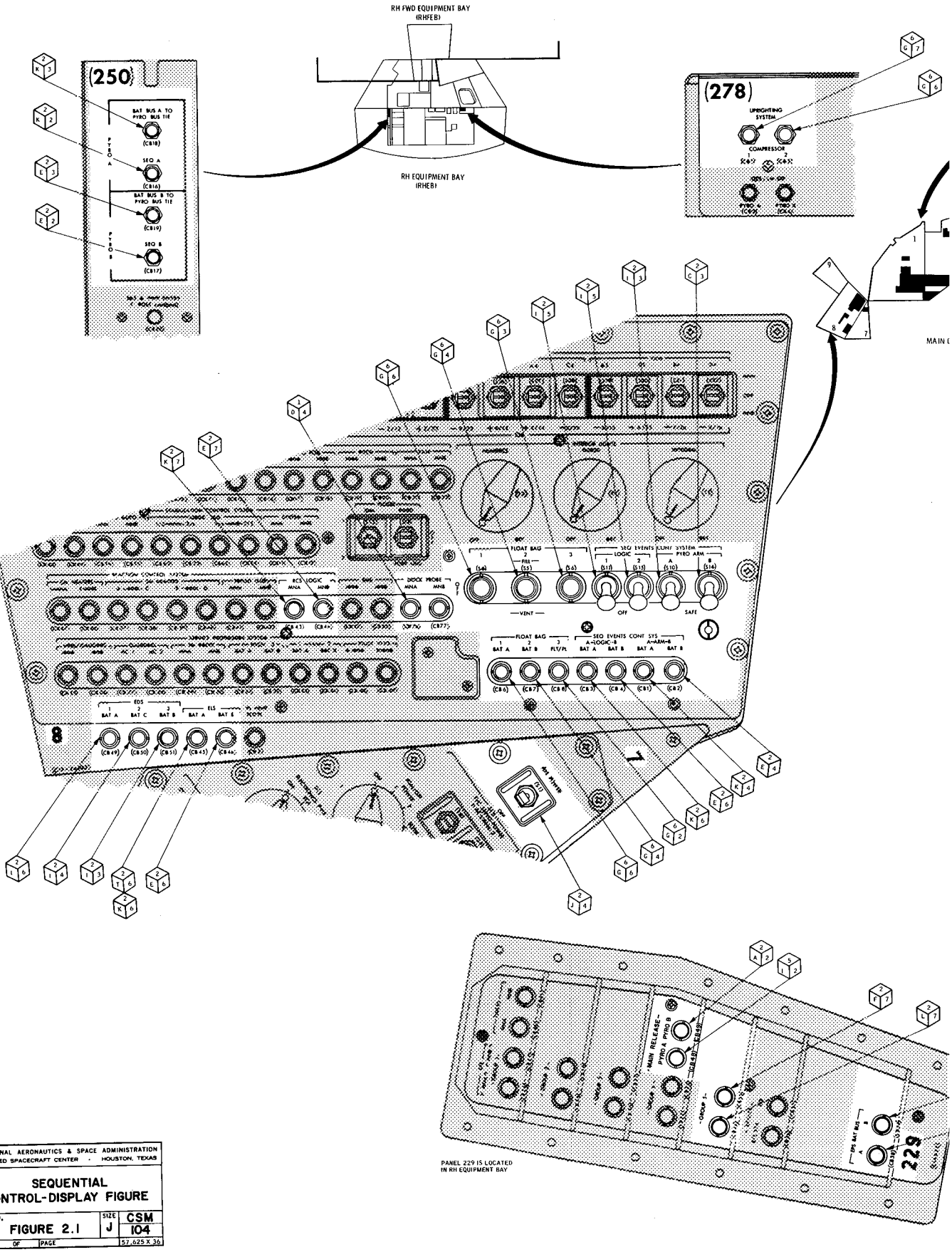
V_{LB1} - LOGIC BUS 1

V_{LB2} - LOGIC BUS 2

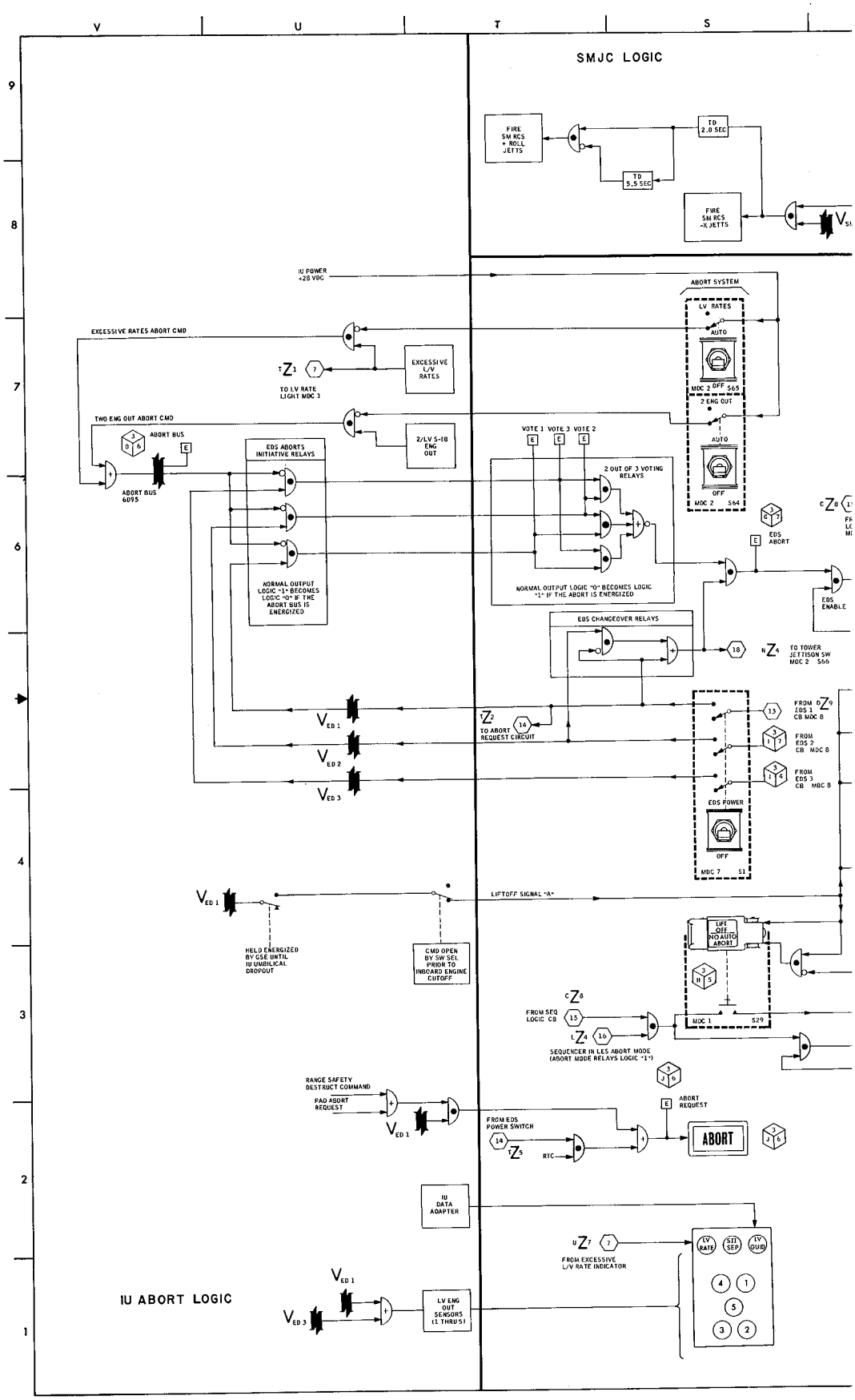
V_{LB3} - LOGIC BUS 3

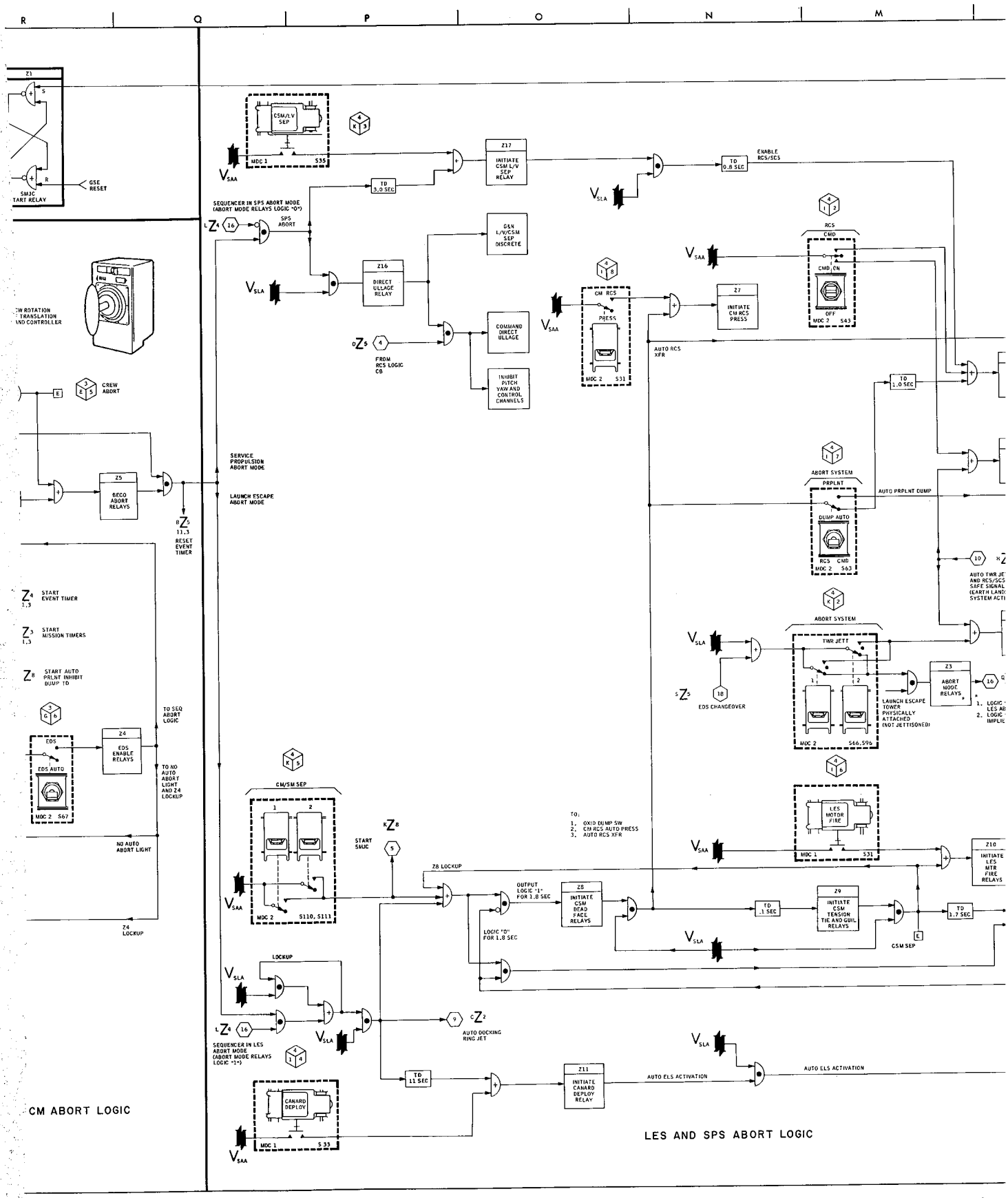
V_{LB4} - LOGIC BUS 4

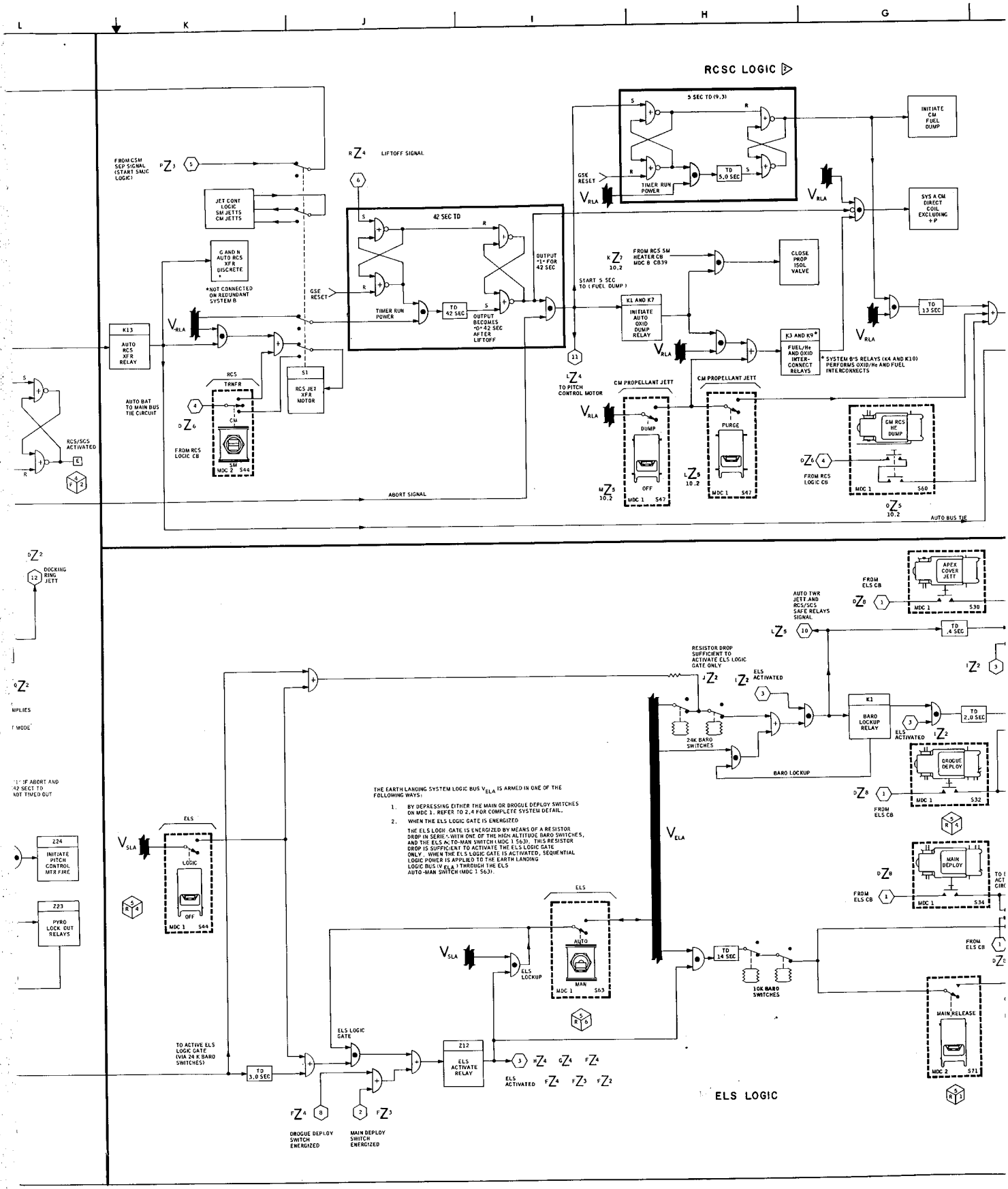

1
2
ABORT
140000
+58944
+35870
-83614
DOCKING PROBE
RETRACT
EXTD/REL
PRIM
SEC
LV ENGINES
LIFT OFF NO AUTO ABORT
APEX COVER JETT
LES MOTOR FIRE
DROGUE DEPLOY
CANARD DEPLOY
MAIN DEPLOY
CSM/LV SEP
CM RCS DUMP
EDS AUTO
CSM/LM 1-FINAL
SEP-2
CM/SM SEP 1
CM/SM SEP 2
S IVB/LM SEP
ABORT SYSTEM LV RATES AUTO
1-TWR JETT-2
PRPLNT DUMP AUTO
2 ENG OUT AUTO
RCS CMD
CM RCS PRESS
RCS CMD TRNFR CM
MAIN RELEASE
RCS LOGIC
RCS AUTO
CM RCS LOGIC
CM PRPLNT DUMP
CM PRPLNT PURGE

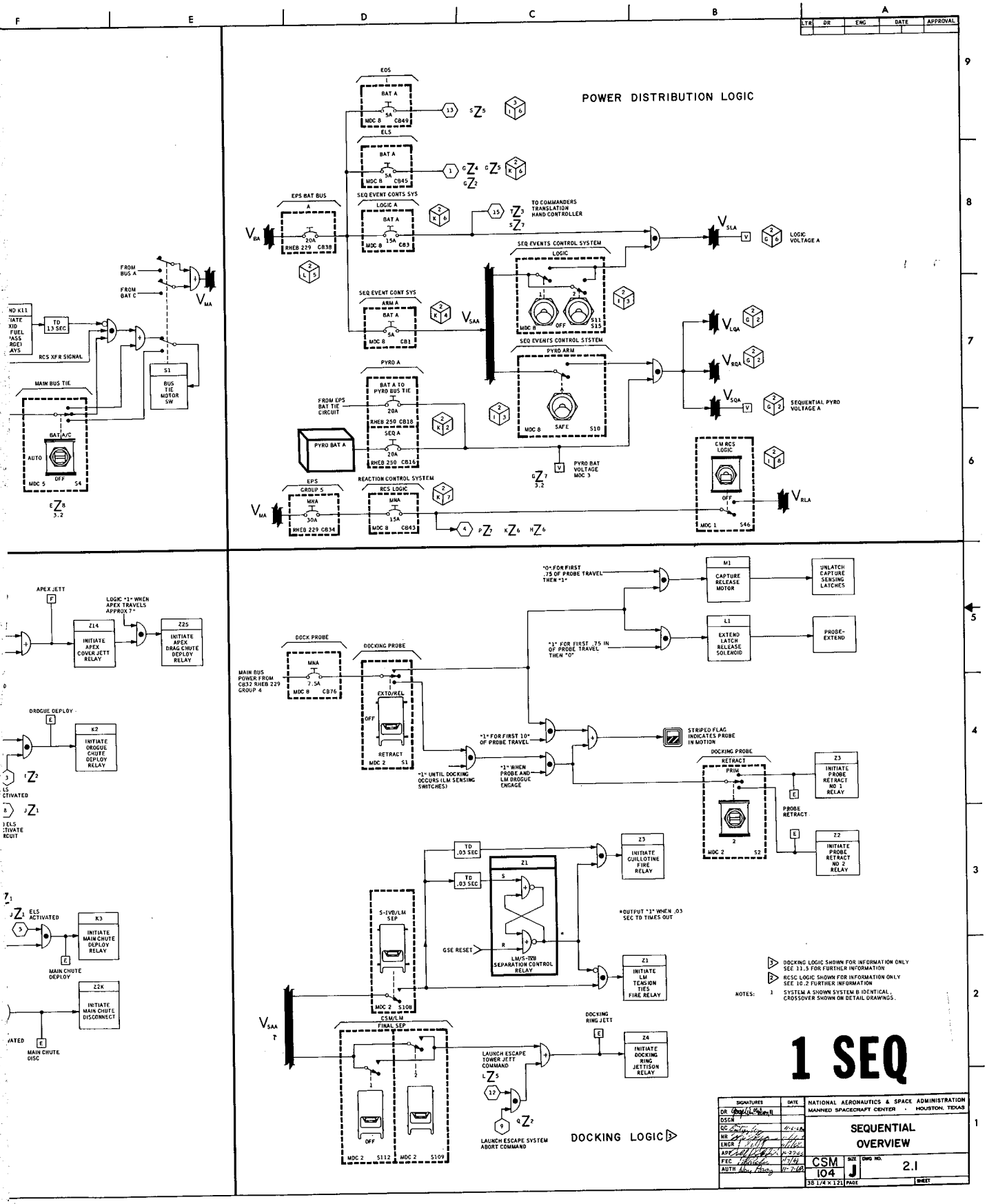


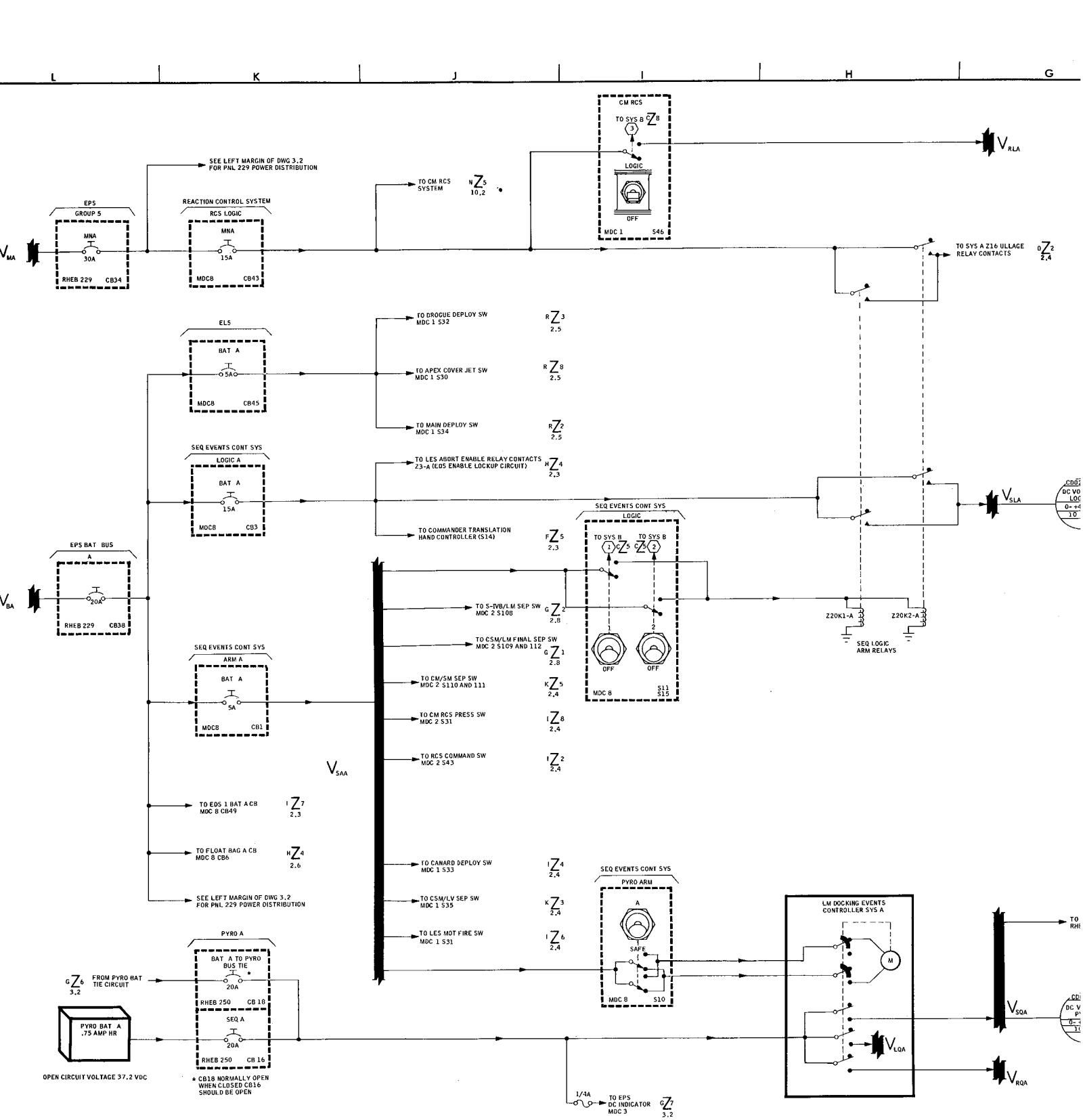
NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER · HOUSTON, TEXAS		
SEQUENTIAL CONTROL-DISPLAY FIGURE		
DWG NO. FIGURE 2.1	SIZE J	CSM 104
SHEET OF PAGE		57.625 X 36

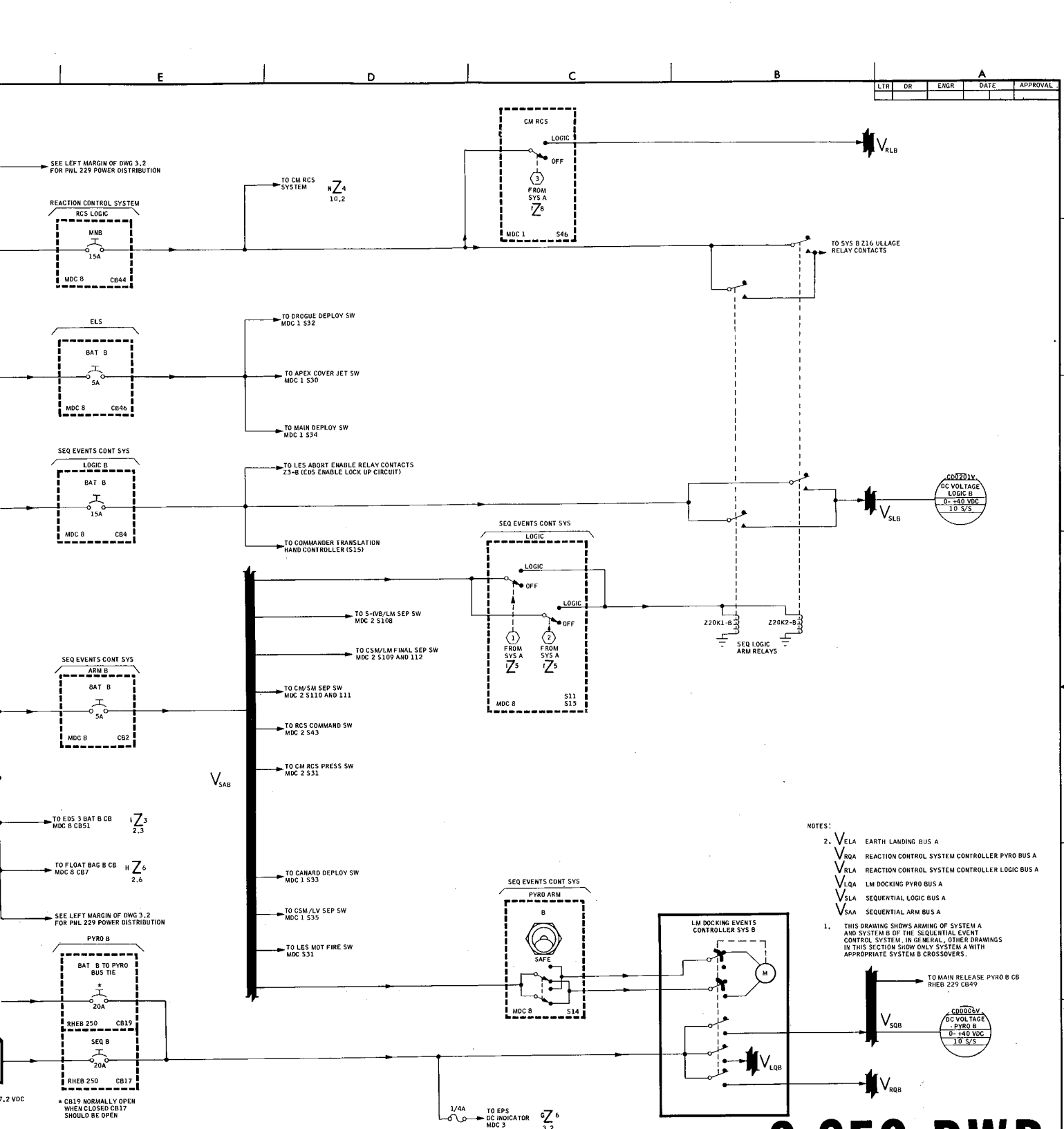

V
U
T
S
9
8
7
6
5
4
3
2
1
SMJC LOGIC
FIRE SM RCS + ROLL JETTS
TO 2.0 SEC
TO 5.5 SEC
FIRE SM RCS -X JETTS
IU POWER +28 VDC
ABORT SYSTEM
LV RATES
AUTO
OFF
MDC 2 S65
2 ENG OUT
AUTO
OFF
MDC 2 S64
EXCESSIVE RATES ABORT CMD
EXCESSIVE L/V RATES
TO LV RATE LIGHT MDC 1
TWO ENG OUT ABORT CMD
2/LV 5-18 ENG OUT
ABORT BUS
ABORT BUS 6095
EDS ABORTS INITIATIVE RELAYS
NORMAL OUTPUT LOGIC "1" BECOMES LOGIC "0" IF THE ABORT BUS IS ENERGIZED
VOTE 1 VOTE 3 VOTE 2
2 OUT OF 3 VOTING RELAYS
NORMAL OUTPUT LOGIC "0" BECOMES LOGIC "1" IF THE ABORT IS ENERGIZED
EDS ABORT
EDS ENABLE
EDS CHANGEOVER RELAYS
TO TOWER JETTISON SW MDC 2 S66
TO ABORT REQUEST CIRCUIT
FROM EDS 1 CB MDC 8
FROM EDS 2 CB MDC 8
FROM EDS 3 CB MDC 8
EDS POWER
OFF
MDC 7 S1
LIFTOFF SIGNAL "A"
HELD ENERGIZED BY GSE UNTIL IU UMBILICAL DROPOUT
CMD OPEN BY SW SEL PRIOR TO INBOARD ENGINE CUTOFF
LIFT OFF NO AUTO ABORT
MDC 1 S29
FROM SEQ LOGIC CB
SEQUENCER IN LES ABORT MODE (ABORT MODE RELAYS LOGIC "1")
RANGE SAFETY DESTRUCT COMMAND
PAO ABORT REQUEST
FROM EDS POWER SWITCH
RTC
ABORT REQUEST
ABORT
IU DATA ADAPTER
FROM EXCESSIVE L/V RATE INDICATOR
LV RATE
SII SEP
LV GUID
IU ABORT LOGIC
LV ENG OUT SENSORS (1 THRU 5)


R
Q
P
O
N
M
Z1
S
R
GSE RESET
SMJC TART RELAY
CSM/LV SEP
MDC 1 S35
Z17
INITIATE CSM L/V SEP RELAY
TD 0.8 SEC
ENABLE RCS/SCS
TD 3.0 SEC
SEQUENCER IN SPS ABORT MODE (ABORT MODE RELAYS LOGIC "0")
SPS ABORT
Z16
DIRECT ULLAGE RELAY
G&N L/V/CSM SEP DISCRETE
COMMAND DIRECT ULLAGE
INHIBIT PITCH YAW AND CONTROL CHANNELS
FROM RCS LOGIC C8
CM RCS PRESS
MDC 2 S31
Z7
INITIATE CM RCS PRESS
RCS CMD
CMD ON
OFF
MDC 2 S43
AUTO RCS XFR
TD 1.0 SEC
CREW ABORT
Z5
BECO ABORT RELAYS
SERVICE PROPULSION ABORT MODE
LAUNCH ESCAPE ABORT MODE
RESET EVENT TIMER
ABORT SYSTEM
PRPLNT
DUMP AUTO
RCS CMD
MDC 2 S63
AUTO PRPLNT DUMP
START EVENT TIMER
START MISSION TIMERS
START AUTO PRLNT INHIBIT DUMP TD
ABORT SYSTEM
TWR JETT
EDS CHANGEOVER
Z3
ABORT MODE RELAYS
LAUNCH ESCAPE TOWER PHYSICALLY ATTACHED (NOT JETTISONED)
MDC 2 S66.5/6
TO SEQ ABORT LOGIC
EDS
EDS AUTO
MDC 2 S67
Z4
EDS ENABLE RELAYS
TO NO AUTO ABORT LIGHT AND Z4 LOCKUP
NO AUTO ABORT LIGHT
Z4 LOCKUP
CM/SM SEP
MDC 2 S110, S111
START SMJC
Z8 LOCKUP
OUTPUT LOGIC "1" FOR 1.8 SEC
LOGIC "0" FOR 1.0 SEC
Z8
INITIATE CSM DEAD FACE RELAYS
TO:
1. OXID DUMP SW
2. CM RCS AUTO PRESS
3. AUTO RCS XFR
LES MOTOR FIRE
MDC 1 S31
Z10
INITIATE LES MTR FIRE RELAYS
TD .1 SEC
Z9
INITIATE CSM TENSION TIE AND GUIL RELAYS
TD 1.7 SEC
CSM SEP
LOCKUP
SEQUENCER IN LES ABORT MODE (ABORT MODE RELAYS LOGIC "1")
AUTO DOCKING RING JET
TD 11 SEC
Z11
INITIATE CANARD DEPLOY RELAY
AUTO ELS ACTIVATION
CANARD DEPLOY
MDC 1 S33
CM ABORT LOGIC
LES AND SPS ABORT LOGIC


RCSC LOGIC
5 SEC TD (9,3)
INITIATE CM FUEL DUMP
SYS A CM DIRECT COIL EXCLUDING +P
FROM CSM SEP SIGNAL (START SM/C LOGIC)
LIFTOFF SIGNAL
JET CONT LOGIC SM JETTS CM JETTS
42 SEC TD
G AND N AUTO RCS XFR DISCRETE *
*NOT CONNECTED ON REDUNDANT SYSTEM B
GSE RESET
OUTPUT *1* FOR 42 SEC
TIMER RUN POWER
TD 42 SEC
OUTPUT BECOMES *0* 42 SEC AFTER LIFTOFF
TD 5.0 SEC
TIMER RUN POWER
GSE RESET
FROM RCS SM HEATER CB MDC 8 CB39
CLOSE PROP ISOL VALVE
START 5 SEC TO (FUEL DUMP)
K1 AND K7
INITIATE AUTO OXID DUMP RELAY
K3 AND K9*
FUEL/He AND OXID INTER-CONNECT RELAYS
* SYSTEM B'S RELAYS (K4 AND K10) PERFORMS OXID/He AND FUEL INTERCONNECTS
TD 13 SEC
K13
AUTO RCS XFR RELAY
AUTO BAT TO MAIN BUS TIE CIRCUIT
RCS TRNFR
CM
SM
MDC 2 S44
FROM RCS LOGIC CB
S1
RCS JET XFR MOTOR
RCS/SCS ACTIVATED
TO PITCH CONTROL MOTOR
CM PROPELLANT JETT
DUMP
OFF
MDC 1 S47
CM PROPELLANT JETT
PURGE
MDC 1 S47
GM RCS HE DUMP
MDC 1 S60
FROM RCS LOGIC CB
ABORT SIGNAL
AUTO BUS TIE
DOCKING RING JETT
AUTO TWR JETT AND RCS/SCS SAFE RELAYS SIGNAL
APEX COVER JETT
MDC 1 S30
FROM ELS CB
TD .4 SEC
RESISTOR DROP SUFFICIENT TO ACTIVATE ELS LOGIC GATE ONLY
ELS ACTIVATED
K1
BARO LOCKUP RELAY
TD 2.0 SEC
24K BARO SWITCHES
BARO LOCKUP
DROGUE DEPLOY
MDC 1 S32
MAIN DEPLOY
MDC 1 S34
THE EARTH LANDING SYSTEM LOGIC BUS V_{ELA} IS ARMED IN ONE OF THE FOLLOWING WAYS:
1. BY DEPRESSING EITHER THE MAIN OR DROGUE DEPLOY SWITCHES ON MDC 1. REFER TO 2.4 FOR COMPLETE SYSTEM DETAIL.
2. WHEN THE ELS LOGIC GATE IS ENERGIZED
THE ELS LOGIC GATE IS ENERGIZED BY MEANS OF A RESISTOR DROP IN SERIES WITH ONE OF THE HIGH ALTITUDE BARO SWITCHES, AND THE ELS AUTO-TO-MAN SWITCH (MDC 1 S63). THIS RESISTOR DROP IS SUFFICIENT TO ACTIVATE THE ELS LOGIC GATE ONLY. WHEN THE ELS LOGIC GATE IS ACTIVATED, SEQUENTIAL LOGIC POWER IS APPLIED TO THE EARTH LANDING LOGIC BUS (V_{ELA}) THROUGH THE ELS AUTO-MAN SWITCH (MDC 1 S63).
ELS
LOGIC
OFF
MDC 1 S44
ELS
AUTO
MAN
MDC 1 S63
ELS LOCKUP
ELS LOGIC GATE
TO ACTIVE ELS LOGIC GATE (VIA 24 K BARO SWITCHES)
TD 3.0 SEC
Z12
ELS ACTIVATE RELAY
ELS ACTIVATED
10K BARO SWITCHES
TD 14 SEC
MAIN RELEASE
MDC 2 S71
DROGUE DEPLOY SWITCH ENERGIZED
MAIN DEPLOY SWITCH ENERGIZED
ELS LOGIC
Z24
INITIATE PITCH CONTROL MTR FIRE
Z23
PYRO LOCK OUT RELAYS


POWER DISTRIBUTION LOGIC
EDS
BAT A
MDC 8 CB49
ELS
BAT A
MDC 8 CB45
EPS BAT BUS
SEQ EVENT CONTS SYS
LOGIC A
BAT A
MDC 8 CB3
TO COMMANDERS TRANSLATION HAND CONTROLLER
SEQ EVENTS CONTROL SYSTEM
LOGIC
MDC 8 S11 S15
SEQ EVENT CONT SYS
ARM A
BAT A
MDC 8 CB1
PYRO A
BAT A TO PYRO BUS TIE
RHEB 250 CB18
SEQ A
RHEB 250 CB16
PYRO BAT A
FROM EPS BAT TIE CIRCUIT
SEQ EVENTS CONTROL SYSTEM
PYRO ARM
MDC 8 SAFE S10
PYRO BAT VOLTAGE MDC 3
EPS
GROUP 5
MNA
RHEB 229 CB34
REACTION CONTROL SYSTEM
RCS LOGIC
MNA
MDC 8 CB43
CM RCS LOGIC
MDC 1 S46
LOGIC VOLTAGE A
SEQUENTIAL PYRO VOLTAGE A
FROM BUS A
FROM BAT C
RCS XFR SIGNAL
TD 13 SEC
MAIN BUS TIE
BUS TIE MOTOR SW
BAT A/C
AUTO
OFF
MDC 5 S4
APEX JETT
LOGIC "1" WHEN APEX TRAVELS APPROX 7°
INITIATE APEX COVER JETT RELAY
INITIATE APEX DRAG CHUTE DEPLOY RELAY
DROGUE DEPLOY
INITIATE DROGUE CHUTE DEPLOY RELAY
ELS ACTIVATED
INITIATE MAIN CHUTE DEPLOY RELAY
MAIN CHUTE DEPLOY
INITIATE MAIN CHUTE DISCONNECT
MAIN CHUTE DISC
"0" FOR FIRST .75 OF PROBE TRAVEL THEN "1"
"1" FOR FIRST .75 IN OF PROBE TRAVEL THEN "0"
UNLATCH CAPTURE SENSING LATCHES
CAPTURE RELEASE MOTOR
EXTEND LATCH RELEASE SOLENOID
PROBE-EXTEND
DOCK PROBE
DOCKING PROBE
MAIN BUS POWER FROM CB32 RHEB 229 GROUP 4
MNA
MDC 8 CB76
EXTD/REL
RETRACT
MDC 2 S1
"1" UNTIL DOCKING OCCURS (LM SENSING SWITCHES)
"1" FOR FIRST 10" OF PROBE TRAVEL
"1" WHEN PROBE AND LM DROGUE ENGAGE
STRIPED FLAG INDICATES PROBE IN MOTION
DOCKING PROBE
RETRACT
PRIM
MDC 2 S2
INITIATE PROBE RETRACT NO 1 RELAY
PROBE RETRACT
INITIATE PROBE RETRACT NO 2 RELAY
TD .03 SEC
TD .03 SEC
INITIATE GUILLOTINE FIRE RELAY
*OUTPUT "1" WHEN .03 SEC TO TIMES OUT
S-IVB/LM SEP
GSE RESET
LM/S-IVB SEPARATION CONTROL RELAY
INITIATE LM TENSION TIES FIRE RELAY
MDC 2 S108
CSM/LM FINAL SEP
MDC 2 S112 MDC 2 S109
DOCKING RING JETT
LAUNCH ESCAPE TOWER JETT COMMAND
INITIATE DOCKING RING JETTISON RELAY
LAUNCH ESCAPE SYSTEM ABORT COMMAND
DOCKING LOGIC
DOCKING LOGIC SHOWN FOR INFORMATION ONLY SEE 11.3 FOR FURTHER INFORMATION
RCSC LOGIC SHOWN FOR INFORMATION ONLY SEE 10.2 FURTHER INFORMATION
NOTES: 1 SYSTEM A SHOWN SYSTEM B IDENTICAL, CROSSOVER SHOWN ON DETAIL DRAWINGS.
1 SEQ
NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS
SEQUENTIAL OVERVIEW
CSM 104
SIZE J
DWG NO. 2.1
38 1/4 X 121
PAGE
SHEET
SIGNATURES
DR
DSCN
QC
NR
ENGR
APP
FEC
AUTH
DATE
LTR DR ENG DATE APPROVAL


L
K
J
I
H
G
CM RCS
TO SYS B
LOGIC
OFF
MDC 1 S46
V_{RLA}
SEE LEFT MARGIN OF DWG 3.2 FOR PNL 229 POWER DISTRIBUTION
TO CM RCS SYSTEM
EPS
GROUP 5
MNA
30A
RHEB 229 CB34
REACTION CONTROL SYSTEM
RCS LOGIC
MNA
15A
MDC8 CB43
V_{MA}
TO SYS A Z16 ULLAGE RELAY CONTACTS
ELS
BAT A
5A
MDC8 CB45
TO DROGUE DEPLOY SW MDC 1 S32
TO APEX COVER JET SW MDC 1 S30
TO MAIN DEPLOY SW MDC 1 S34
SEQ EVENTS CONT SYS
LOGIC A
BAT A
15A
MDC8 CB3
TO LES ABORT ENABLE RELAY CONTACTS Z3-A (EDS ENABLE LOCKUP CIRCUIT)
TO COMMANDER TRANSLATION HAND CONTROLLER (S14)
SEQ EVENTS CONT SYS
LOGIC
TO SYS B
TO SYS B
OFF
OFF
MDC 8 S11 S15
V_{SLA}
Z20K1-A
Z20K2-A
SEQ LOGIC ARM RELAYS
EPS BAT BUS A
20A
RHEB 229 CB38
V_{BA}
TO S-IVB/LM SEP SW MDC 2 S108
TO CSM/LM FINAL SEP SW MDC 2 S109 AND 112
SEQ EVENTS CONT SYS
ARM A
BAT A
5A
MDC8 CB1
TO CM/SM SEP SW MDC 2 S110 AND 111
TO CM RCS PRESS SW MDC 2 S31
TO RCS COMMAND SW MDC 2 S43
V_{SAA}
TO EDS 1 BAT A CB MDC 8 CB49
TO FLOAT BAG A CB MDC 8 CB6
SEE LEFT MARGIN OF DWG 3.2 FOR PNL 229 POWER DISTRIBUTION
TO CANARD DEPLOY SW MDC 1 S33
TO CSM/LV SEP SW MDC 1 S35
TO LES MOT FIRE SW MDC 1 S31
SEQ EVENTS CONT SYS
PYRO ARM
A
SAFE
MDC 8 S10
LM DOCKING EVENTS CONTROLLER SYS A
M
V_{SQA}
V_{LQA}
V_{RQA}
PYRO A
BAT A TO PYRO BUS TIE *
20A
RHEB 250 CB 18
SEQ A
20A
RHEB 250 CB 16
FROM PYRO BAT TIE CIRCUIT
PYRO BAT A .75 AMP HR
OPEN CIRCUIT VOLTAGE 37.2 VDC
* CB18 NORMALLY OPEN WHEN CLOSED CB16 SHOULD BE OPEN
1/4A
TO EPS DC INDICATOR MDC 3



2 SEQ PWR

SIGNATURES	DATE
DR	
DSGN	
QC	11-6-68
ENGR	11-6-68
NR	11-6-68
APP	11-6-68
FEC	11-6-68
AUTH	11-6-68

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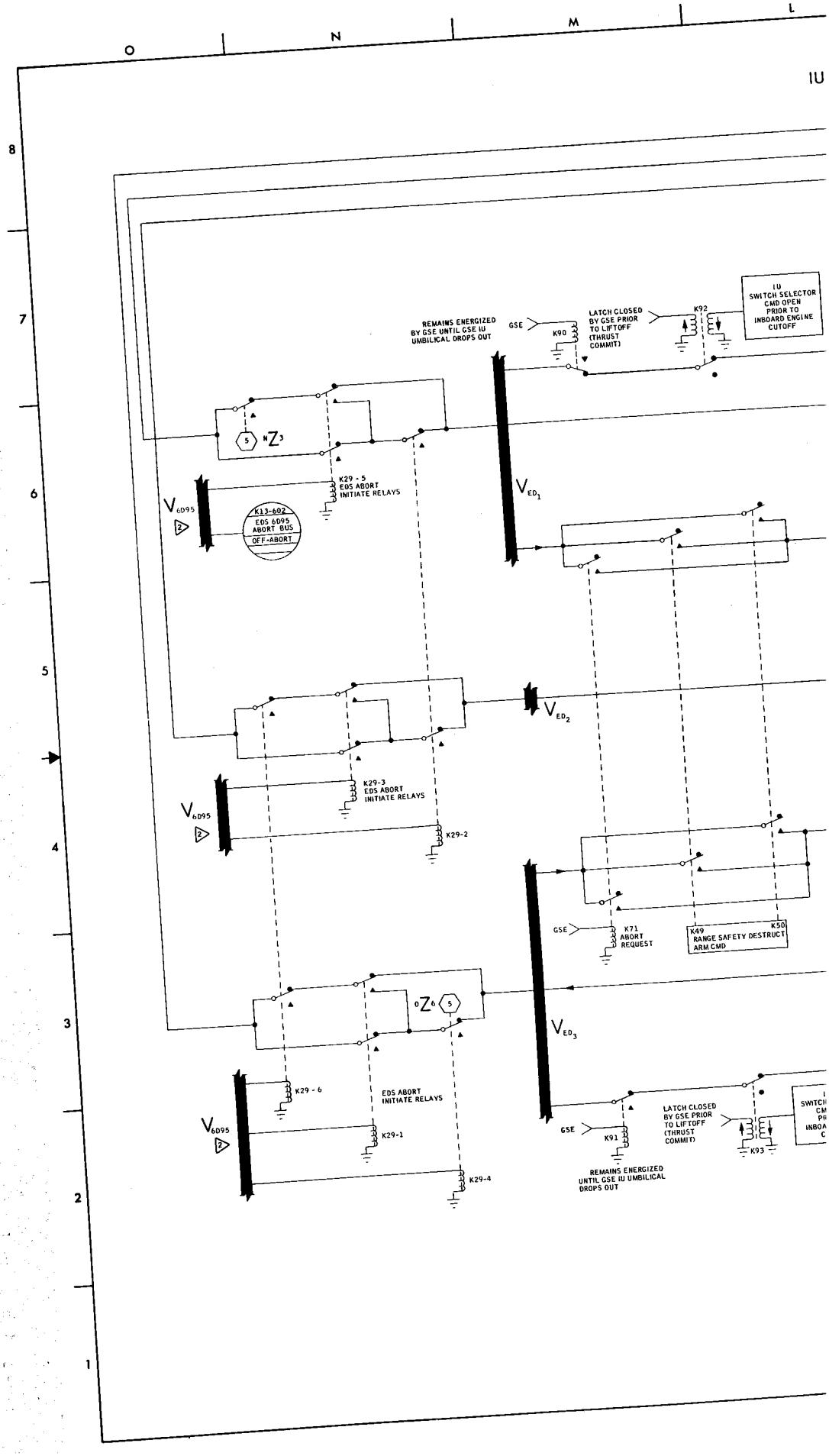
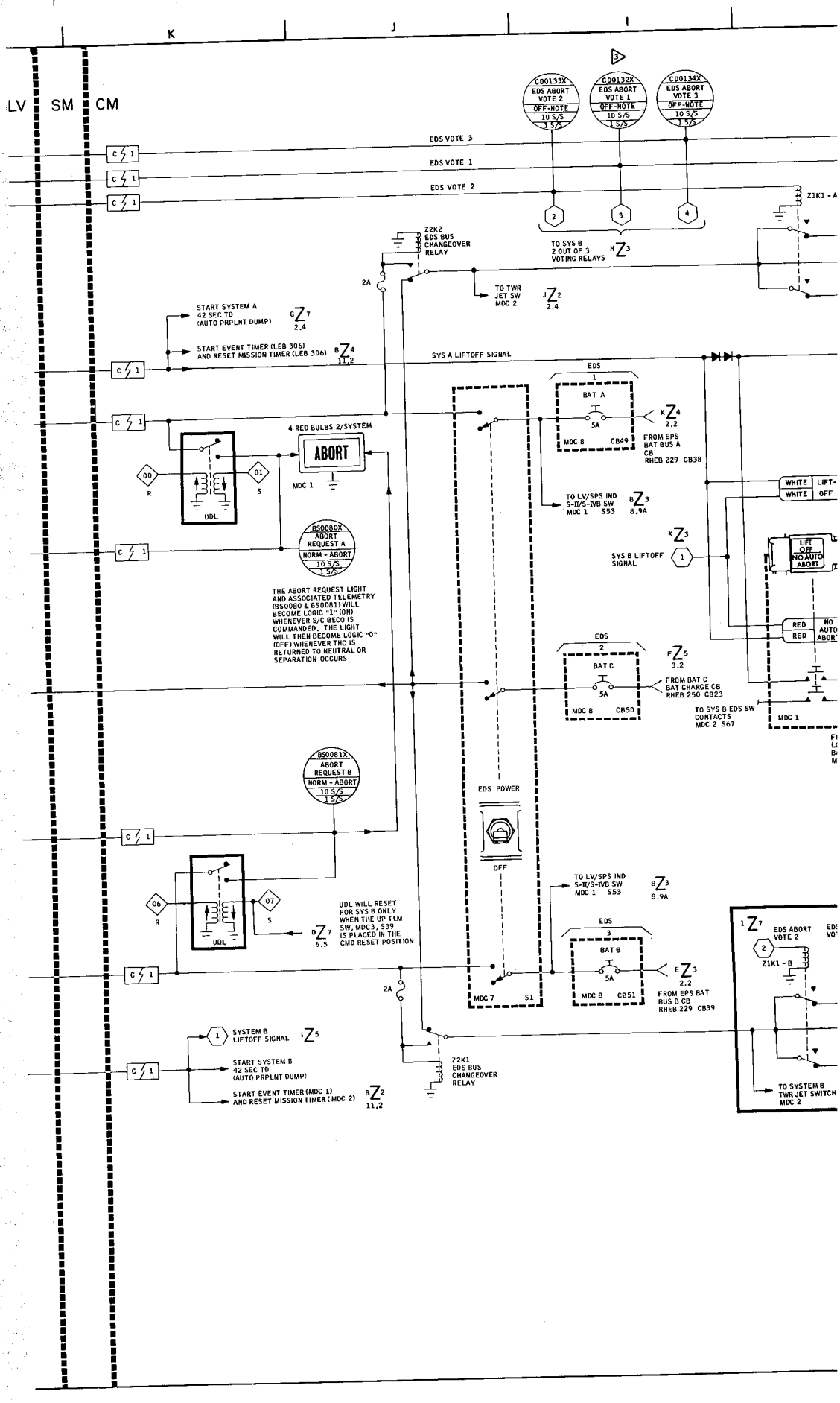
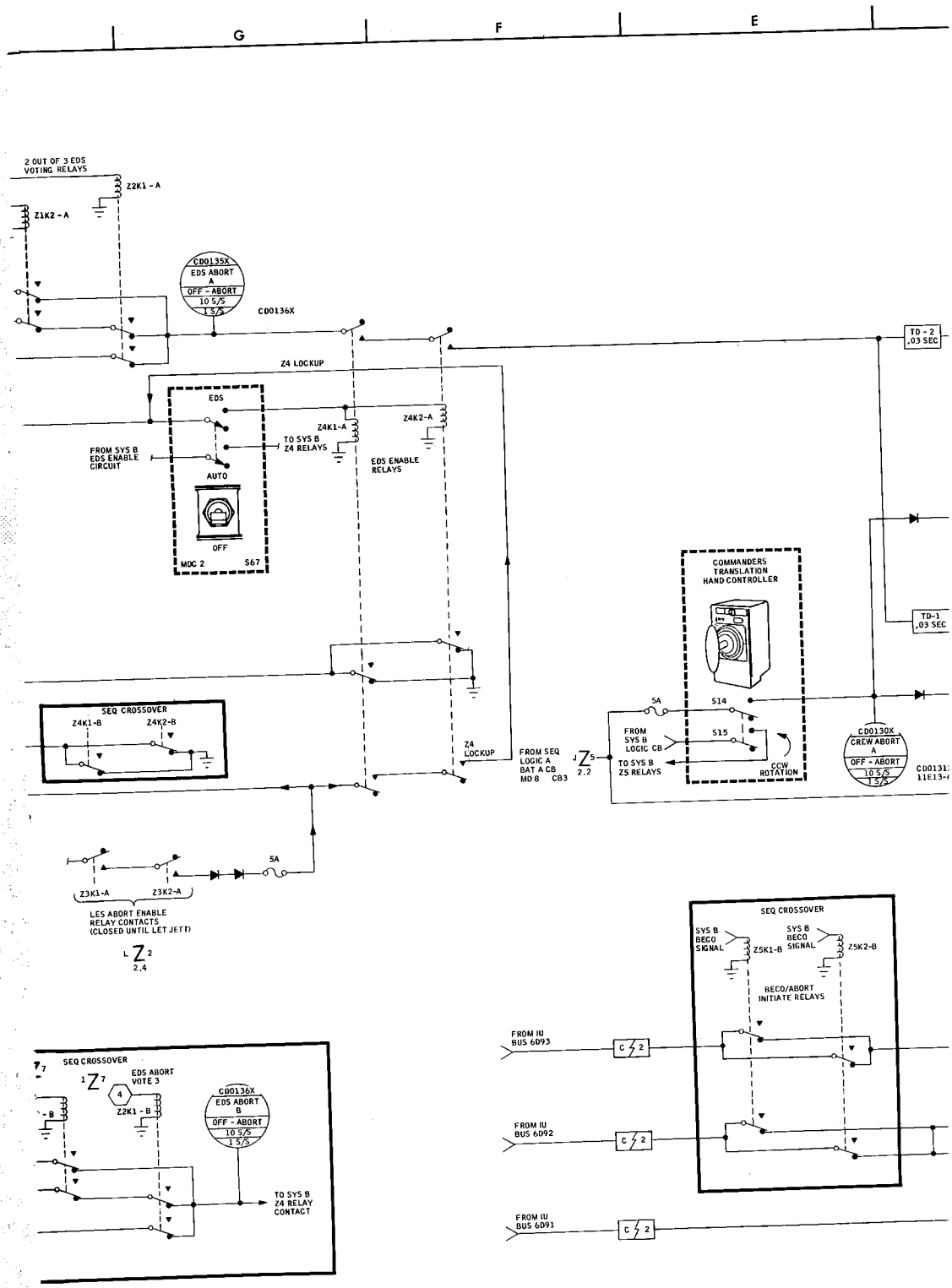
SEQUENTIAL POWER DISTRIBUTION

CSM 104 | SIZE J | DWG NO. 2.2 | SHEET 1 OF 1

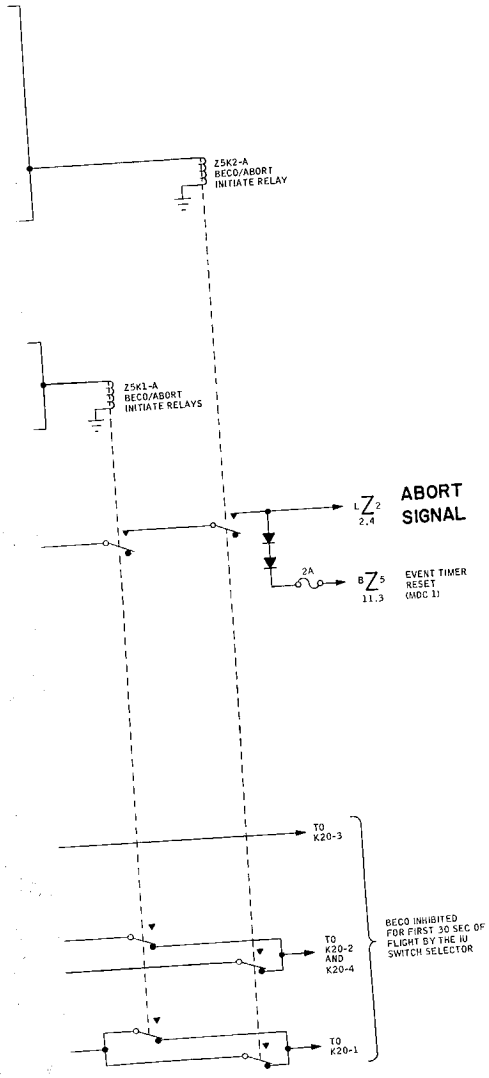
66 x 34


O
N
M
L
IU
8
7
6
5
4
3
2
1
REMAINS ENERGIZED BY GSE UNTIL GSE IU UMBILICAL DROPS OUT
GSE
K90
LATCH CLOSED BY GSE PRIOR TO LIFTOFF (THRUST COMMIT)
K92
IU SWITCH SELECTOR CMD OPEN PRIOR TO INBOARD ENGINE CUTOFF
NZ3
K29 - 5 EDS ABORT INITIATE RELAYS
V6D95
K13-602 EDS 6D95 ABORT BUS OFF-ABORT
VED1
VED2
K29-3 EDS ABORT INITIATE RELAYS
K29-2
GSE
K71 ABORT REQUEST
K49 RANGE SAFETY DESTRUCT ARM CMD
K50
0Z6
VED3
K29 - 6
EDS ABORT INITIATE RELAYS
K29-1
K29-4
GSE
K91
LATCH CLOSED BY GSE PRIOR TO LIFTOFF (THRUST COMMIT)
K93
REMAINS ENERGIZED UNTIL GSE IU UMBILICAL DROPS OUT


K
J
I
LV
SM
CM
C0133X EDS ABORT VOTE 2 OFF-NOTE 10 S/S 1 S/S
C0132X EDS ABORT VOTE 1 OFF-NOTE 10 S/S 1 S/S
C0134X EDS ABORT VOTE 3 OFF-NOTE 10 S/S 1 S/S
EDS VOTE 3
EDS VOTE 1
EDS VOTE 2
TO SYS B 2 OUT OF 3 VOTING RELAYS
Z2K2 EDS BUS CHANGEOVER RELAY
TO TWR JET SW MDC 2
START SYSTEM A 42 SEC TD (AUTO PRPLNT DUMP)
START EVENT TIMER (LEB 306) AND RESET MISSION TIMER (LEB 306)
SYS A LIFTOFF SIGNAL
4 RED BULBS 2/SYSTEM
ABORT
MDC 1
UDL
B50080X ABORT REQUEST A NORM - ABORT 10 S/S 1 S/S
THE ABORT REQUEST LIGHT AND ASSOCIATED TELEMETRY (B50080 & B50081) WILL BECOME LOGIC "1" (ON) WHENEVER S/C BECO IS COMMANDED. THE LIGHT WILL THEN BECOME LOGIC "0" (OFF) WHENEVER THC IS RETURNED TO NEUTRAL OR SEPARATION OCCURS
B50081X ABORT REQUEST B NORM - ABORT 10 S/S 1 S/S
UDL WILL RESET FOR SYS B ONLY WHEN THE UP TLM SW, MDC3, S39 IS PLACED IN THE CMD RESET POSITION
EDS 1 BAT A 5A MDC 8 CB49
FROM EPS BAT BUS A CB RHEB 229 CB3B
EDS 2 BAT C 5A MDC 8 CB50
FROM BAT C BAT CHARGE CB RHEB 250 CB23
EDS 3 BAT B 5A MDC 8 CB51
FROM EPS BAT BUS B CB RHEB 229 CB39
EDS POWER
OFF
MDC 7 S1
TO LV/SPS IND S-II/S-IVB SW MDC 1 S53
SYS B LIFTOFF SIGNAL
START SYSTEM B 42 SEC TD (AUTO PRPLNT DUMP)
START EVENT TIMER (MDC 1) AND RESET MISSION TIMER (MDC 2)
Z2K1 EDS BUS CHANGEOVER RELAY
WHITE LIFT-
WHITE OFF
LIFT OFF NO AUTO ABORT
RED NO AUTO
RED ABOR
TO SYS B EDS SW CONTACTS MDC 2 S67
MDC 1
EDS ABORT VOTE 2
Z1K1 - B
TO SYSTEM B TWR JET SWITCH MDC 2
Z1K1 - A


G
F
E
2 OUT OF 3 EDS VOTING RELAYS
Z2K1 - A
Z1K2 - A
CD0135X
EDS ABORT A
OFF - ABORT
10 S/S
1 S/S
CD0136X
Z4 LOCKUP
EDS
Z4K1-A
Z4K2-A
FROM SYS B EDS ENABLE CIRCUIT
TO SYS B Z4 RELAYS
EDS ENABLE RELAYS
AUTO
OFF
MDC 2
S67
TD - 2 .03 SEC
TD-1 .03 SEC
COMMANDERS TRANSLATION HAND CONTROLLER
SEQ CROSSOVER
Z4K1-B
Z4K2-B
Z4 LOCKUP
FROM SEQ LOGIC A BAT A CB MD 8 CB3
J Z5 2.2
5A
S14
S15
FROM SYS B LOGIC CB
TO SYS B Z5 RELAYS
CCW ROTATION
CD0130X
CREW ABORT A
OFF - ABORT
10 S/S
1 S/S
Z3K1-A
Z3K2-A
LES ABORT ENABLE RELAY CONTACTS (CLOSED UNTIL LET JETT)
L Z 2 2.4
SEQ CROSSOVER
SYS B BECO SIGNAL
Z5K1-B
SYS B BECO SIGNAL
Z5K2-B
BECO/ABORT INITIATE RELAYS
FROM IU BUS 6093
FROM IU BUS 6092
FROM IU BUS 6091
C 2
SEQ CROSSOVER
1 Z 7
EDS ABORT VOTE 3
Z2K1 - B
CD0136X
EDS ABORT B
OFF - ABORT
10 S/S
1 S/S
TO SYS B Z4 RELAY CONTACT

LTR	DR	ENGR	DATE	APPROVAL



3 THE EDS ABORT VOTE 1, 2 AND 3 MEASUREMENTS MAY BECOME LOGIC "0" IF THE BUS VOLTAGE BECOMES LESS THAN 23.4 VDC

2 A. THE EDS ABORT BUS 6D95 MAY BE ARMED IN ONE OF THE FOLLOWING MANNERS:

1. L/V PITCH AND YAW RATES >5 DEG/SEC
2. L/V RATES >20 DEG/SEC IN ROLL
3. TWO FIRST STAGE ENGINES DEVELOP < 90% RATED THRUST

B. THE ABOVE ABORT INPUTS TO EDS ABORT BUS 6D95 MAY BE DISABLED IN ONE OF THE FOLLOWING MANNERS:

1. L/V RATE BY L/V RATE SWITCH TO OFF (MDC 2 S65)
2. 2 ENG OUT BY 2 ENG OUT SWITCH TO OFF (MDC 2 S64)
3. BY IU SWITCH SELECTOR PRIOR TO S IC/S II STAGING

NOTES: 1 SYSTEM A SHOWN WITH SYSTEM B CROSSOVERS; SYSTEM B IS IDENTICAL

3 ABORT INIT

SIGNATURES	DATE
DR W. J. Bailey	
DSGN	
QC B. Pate	11-6-68
ENGR	11-6-68
NR	11-6-68
APP	11-7-68
FEC	11-7-68
AUTH	11-7-68

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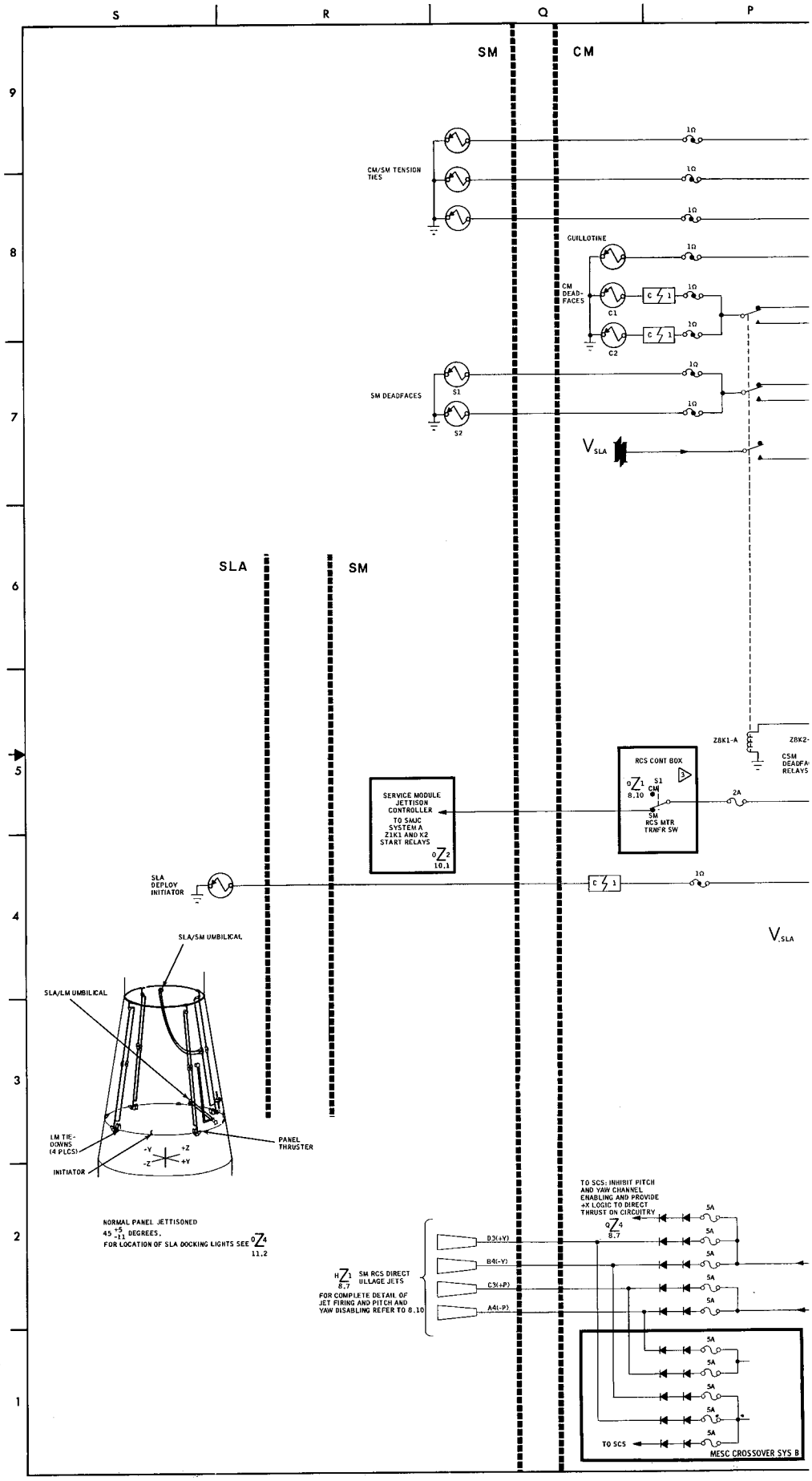
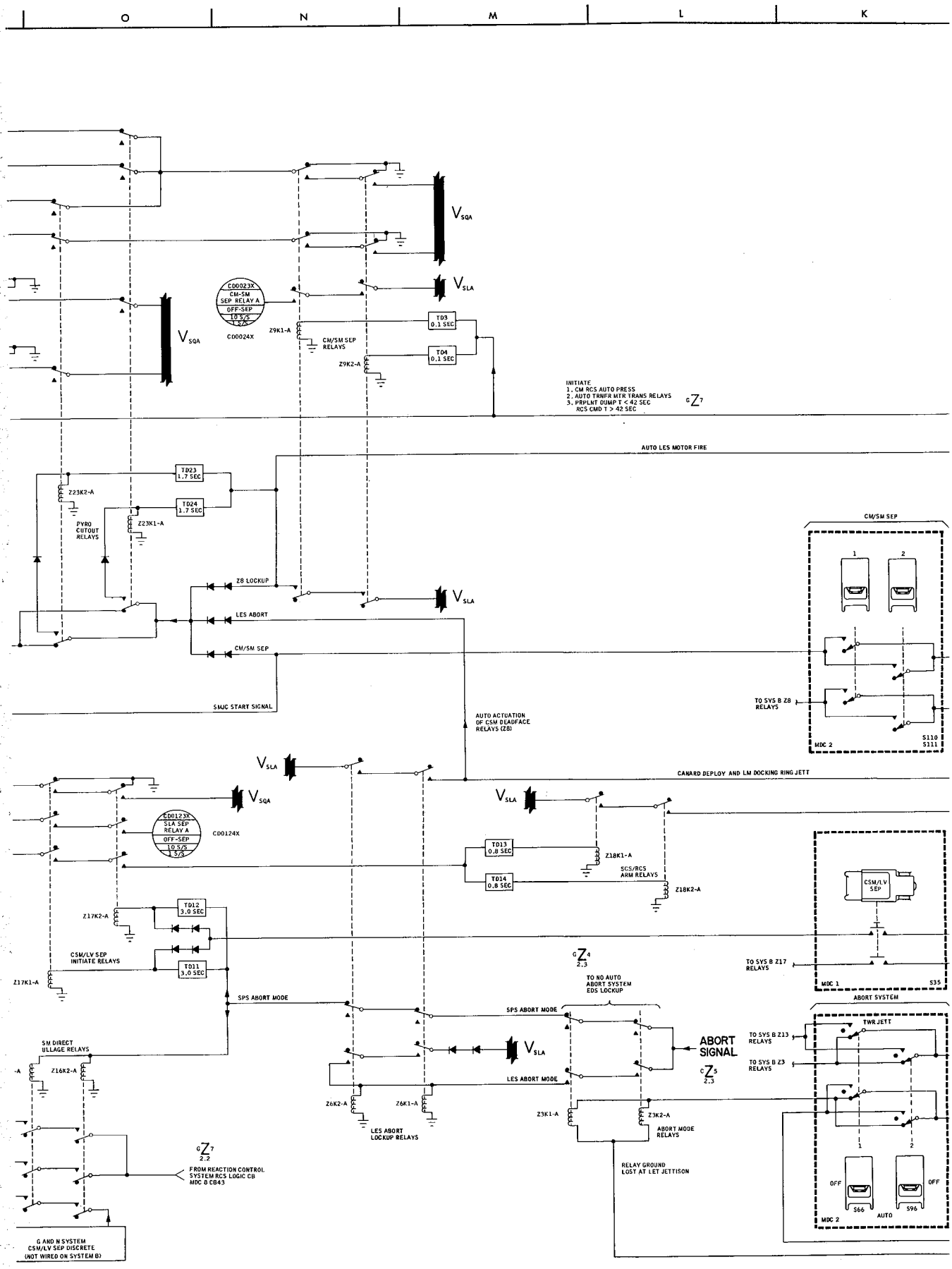
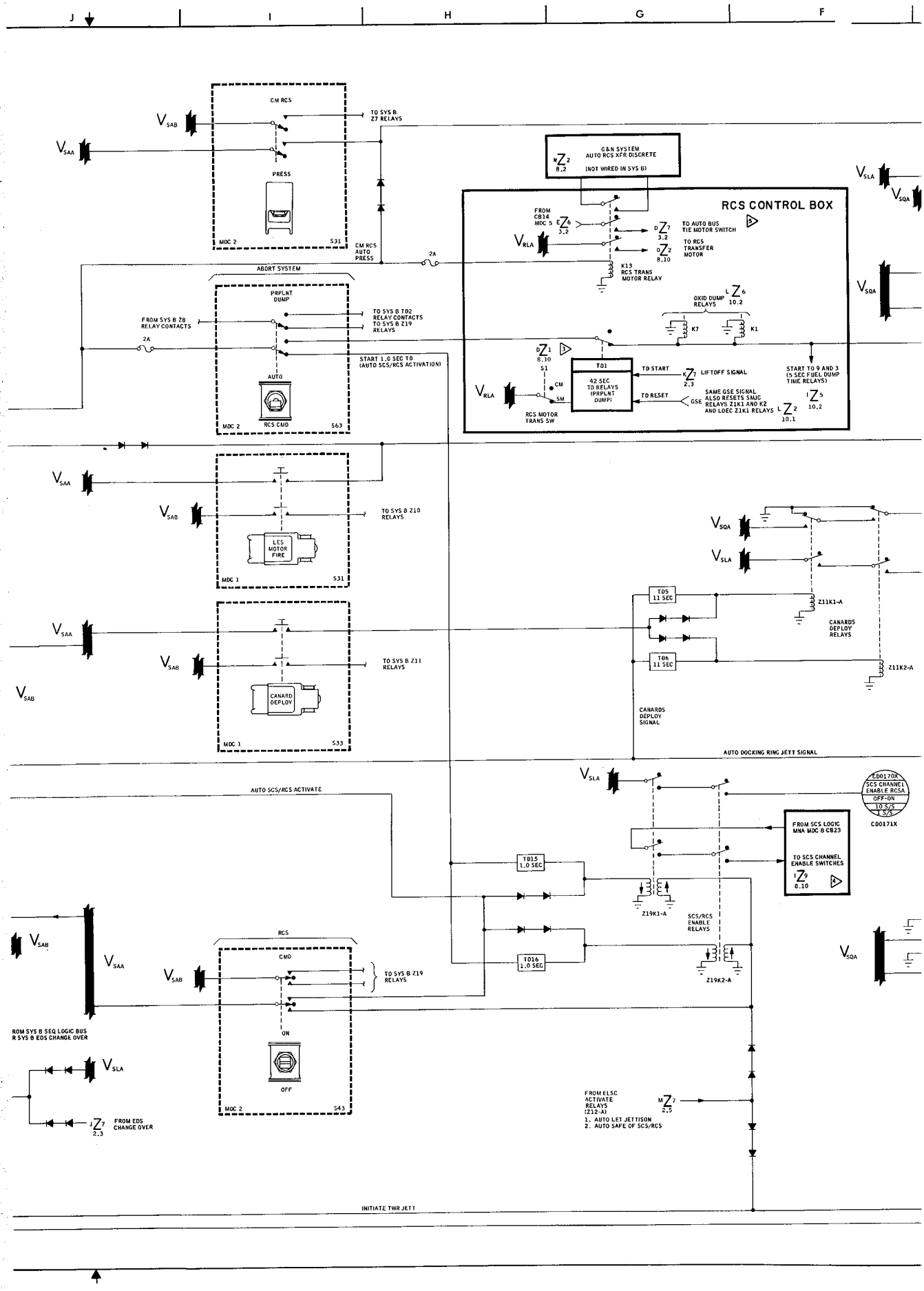
SEQUENTIAL ABORT INITIATION

CSM	SIZE	DWG NO.	2.3
104	J		
82.5" X 34"	PAGE		SHEET


S
R
Q
P
SM
CM
SLA
SM
CM/SM TENSION TIES
GUILLOTINE
CM DEAD-FACES
C1
C2
SM DEADFACES
S1
S2
1Ω
2A
V_{SLA}
SERVICE MODULE JETTISON CONTROLLER
TO SMJC SYSTEM A Z1K1 AND X2 START RELAYS
0Z2 10.1
RCS CONT BOX
0Z1 8.10
S1
CM
SM RCS MTR TRNFR SW
Z8K1-A
Z8K2-
CSM DEADFA RELAYS
SLA DEPLOY INITIATOR
SLA/SM UMBILICAL
SLA/LM UMBILICAL
LM TIE-DOWNS (4 PLCS)
PANEL THRUSTER
INITIATOR
-V
+Z
-Z
+Y
NORMAL PANEL JETTISONED
45 +5 -1 DEGREES.
FOR LOCATION OF SLA DOCKING LIGHTS SEE 0Z4 11.2
TO SCS- INHIBIT PITCH AND YAW CHANNEL ENABLING AND PROVIDE +X LOGIC TO DIRECT THRUST ON CIRCUITRY
0Z4 8.7
5A
D3(+Y)
B4(-Y)
C3(+P)
A4(-P)
HZ1 8.7 SM RCS DIRECT ULLAGE JETS
FOR COMPLETE DETAIL OF JET FIRING AND PITCH AND YAW DISABLING REFER TO 8.10
TO SCS
MESC CROSSOVER SYS B


O
N
M
L
K
V_{SQA}
V_{SLA}
CD0023X
CM-SM SEP RELAY A
OFF-SEP
1.0 S/S
1.5/S
CD0024X
Z9K1-A
CM/SM SEP RELAYS
Z9K2-A
TD3 0.1 SEC
TD4 0.1 SEC
INITIATE
1. CM RCS AUTO PRESS
2. AUTO TRNFR MTR TRANS RELAYS
3. PRPLNT DUMP T < 42 SEC
RCS CMD T > 42 SEC
C Z 7
AUTO LES MOTOR FIRE
TD23 1.7 SEC
TD24 1.7 SEC
Z23K2-A
Z23K1-A
PYRO CUTOUT RELAYS
Z8 LOCKUP
LES ABORT
CM/SM SEP
SMJC START SIGNAL
AUTO ACTUATION OF CSM DEADFACE RELAYS (Z8)
CM/SM SEP
1
2
TO SYS B Z8 RELAYS
MDC 2
S110
S111
CANARD DEPLOY AND LM DOCKING RING JETT
CD0123X
SLA SEP RELAY A
OFF-SEP
1.0 S/S
1.5/S
CD0124X
TD13 0.8 SEC
TD14 0.8 SEC
Z18K1-A
SCS/RCS ARM RELAYS
Z18K2-A
CSM/LV SEP
TO SYS B Z17 RELAYS
MDC 1
S35
TD12 3.0 SEC
TD11 3.0 SEC
Z17K2-A
Z17K1-A
CSM/LV SEP INITIATE RELAYS
C Z 4 2.3
TO NO AUTO ABORT SYSTEM EDS LOCKUP
SPS ABORT MODE
SPS ABORT MODE
ABORT SYSTEM
TWR JETT
TO SYS B Z13 RELAYS
TO SYS B Z3 RELAYS
ABORT SIGNAL
C Z 5 2.3
LES ABORT MODE
SM DIRECT ULLAGE RELAYS
Z16K2-A
Z6K2-A
Z6K1-A
LES ABORT LOCKUP RELAYS
Z3K1-A
Z3K2-A
ABORT MODE RELAYS
RELAY GROUND LOST AT LET JETTISON
C Z 7 2.2
FROM REACTION CONTROL SYSTEM RCS LOGIC CB MDC 8 CB43
G AND N SYSTEM CSM/LV SEP DISCRETE (NOT WIRED ON SYSTEM B)
OFF
OFF
S66
S96
AUTO
MDC 2


J
I
H
G
F
CM RCS
PRESS
MDC 2
S31
TO SYS B Z7 RELAYS
CM RCS AUTO PRESS
2A
G&N SYSTEM AUTO RCS XFR DISCRETE
(NOT WIRED IN SYS B)
RCS CONTROL BOX
FROM CB14 MDC 5
TO AUTO BUS TIE MOTOR SWITCH
TO RCS TRANSFER MOTOR
K13 RCS TRANS MOTOR RELAY
ABORT SYSTEM
PRPLNT DUMP
FROM SYS B Z8 RELAY CONTACTS
TO SYS B TD2 RELAY CONTACTS TO SYS B Z19 RELAYS
START 1.0 SEC TO (AUTO SCS/RCS ACTIVATION)
AUTO
RCS CMD
MDC 2
S63
OXID DUMP RELAYS
K7
K1
TD1
42 SEC TO RELAYS (PRPLNT DUMP)
TO START
LIFTOFF SIGNAL
TO RESET
GSE
SAME GSE SIGNAL ALSO RESETS SMJC RELAYS Z1K1 AND K2 AND LOEC Z1K1 RELAYS
START TO 9 AND 3 (5 SEC FUEL DUMP TIME RELAYS)
S1
CM
SM
RCS MOTOR TRANS SW
LES MOTOR FIRE
TO SYS B Z10 RELAYS
MDC 1
S31
CANARD DEPLOY
TO SYS B Z11 RELAYS
MDC 1
S33
TD5 11 SEC
TD6 11 SEC
Z11K1-A
Z11K2-A
CANARDS DEPLOY RELAYS
CANARDS DEPLOY SIGNAL
AUTO DOCKING RING JETT SIGNAL
AUTO SCS/RCS ACTIVATE
CD0170X SCS CHANNEL ENABLE RCSA OFF-ON 10 S/S 1 S/S
CD0171X
FROM SCS LOGIC MNA MDC 8 CB23
TO SCS CHANNEL ENABLE SWITCHES
TD15 1.0 SEC
TD16 1.0 SEC
Z19K1-A
Z19K2-A
SCS/RCS ENABLE RELAYS
RCS
CMD
ON
OFF
MDC 2
S43
TO SYS B Z19 RELAYS
ROM SYS B SEQ LOGIC BUS R SYS B EDS CHANGE OVER
FROM EDS CHANGE OVER
FROM ELSC ACTIVATE RELAYS (Z12-A)
1. AUTO LET JETTISON
2. AUTO SAFE OF SCS/RCS
INITIATE TWR JETT

LTR	DR	ENGR	DATE	APPROVAL

CM | LET

CM RCS PRESS RELAYS

Z7K1-A

Z7K2-A

C00173X CM RCS PRESS OFF-ON 10 S/S 1 S/S

C00174X

1Ω

SYS A

CM RCS PRESS

SYS B

1Ω

R Z5 10,2

1. NORMAL THRUST OF 150,000 LB
2. RISE TIME OF APPROX .4 SEC
3. TAIL OFF WITHIN APPROX 8 SEC

LES MOTOR FIRE

1Ω

PITCH CONTROL MOTOR FIRE

1. NORMAL THRUST OF 2850 LB
2. RISE TIME OF APPROX .25 SEC
3. TAIL OFF WITHIN APPROX .6± .1 SEC

Z24K1-A

Z24K2-A

PITCH CONTROL MOTOR FIRE RELAYS

Z10K1-A

Z10K2-A

LES MOTOR FIRE RELAYS

1Ω

CANARDS DEPLOY DEPLOYS WITHIN .3 SEC

Z5 5 TO AUTO ELSC ACTIVATE

PITCH CONTROL MOTOR

TOWER JETTISON MOTOR

STRUCTURAL SKIRT

NOSE CONE AND Q BALL

BALLAST

LAUNCH ESCAPE MOTOR THRUST ALIGNMENT FITTING

LAUNCH ESCAPE MOTOR

SATURN V DAMPER

STUD AND FRANGIBLE NUT

BOOST PROTECTIVE COVER (APEX SECTION)

STUD AND FRANGIBLE NUT

CANARD

SOLID PROPELLANT

CANARD ACTUATOR

+Z +X +Y -Y -X -Z

LAUNCH ESCAPE TOWER

POWER SYSTEMS AND INSTRUMENTATION WIRE HARNESS

STUD AND FRANGIBLE NUT

BUNA N RUBBER INSULATION

STUD AND FRANGIBLE NUT

ELECTRICAL DISCONNECT FITTINGS

H Z1 2,7 TO AUTO LM DOCKING RING JETTISON RELAY Z4

1Ω

TWR JETTISON MOTOR

1. NORMAL THRUST OF 32,000 LB
2. RISE TIME OF APPROX .2 SEC
3. TAIL OFF WITHIN APPROX 1.4 SEC

LET TOWER FRANGIBLE NUTS

GROUND LOST AT LET JETTISON

TOWER JETTISON RELAYS

Z13K1-A

Z13K2-A

3 SYSTEM A AND B CIRCUITRY ARE LOCATED IN THE SAME RCSC BOX AND HENCE HAVE DIFFERENT RELAY DESIGNATIONS. REFERENCE SHOULD BE MADE TO DRAWING 10,2 FOR COMPLETE SYSTEM OPERATION

2 Z19-B RELAY CONTACTS RECEIVE POWER FROM SCS LOGIC MNB PWR (MDC 8, CB64)

1 S1 TRANSFERS WHEN RCS JET CONTROLS ARE TRANSFERED FROM SM TO CM

1 SYS A SHOWN EXCEPT WHERE NOTED

4 ABORT

SIGNATURES	DATE
DR	
DSGN	
QC	
ENGR	
NR	
APP	
FEC	
AUTH	

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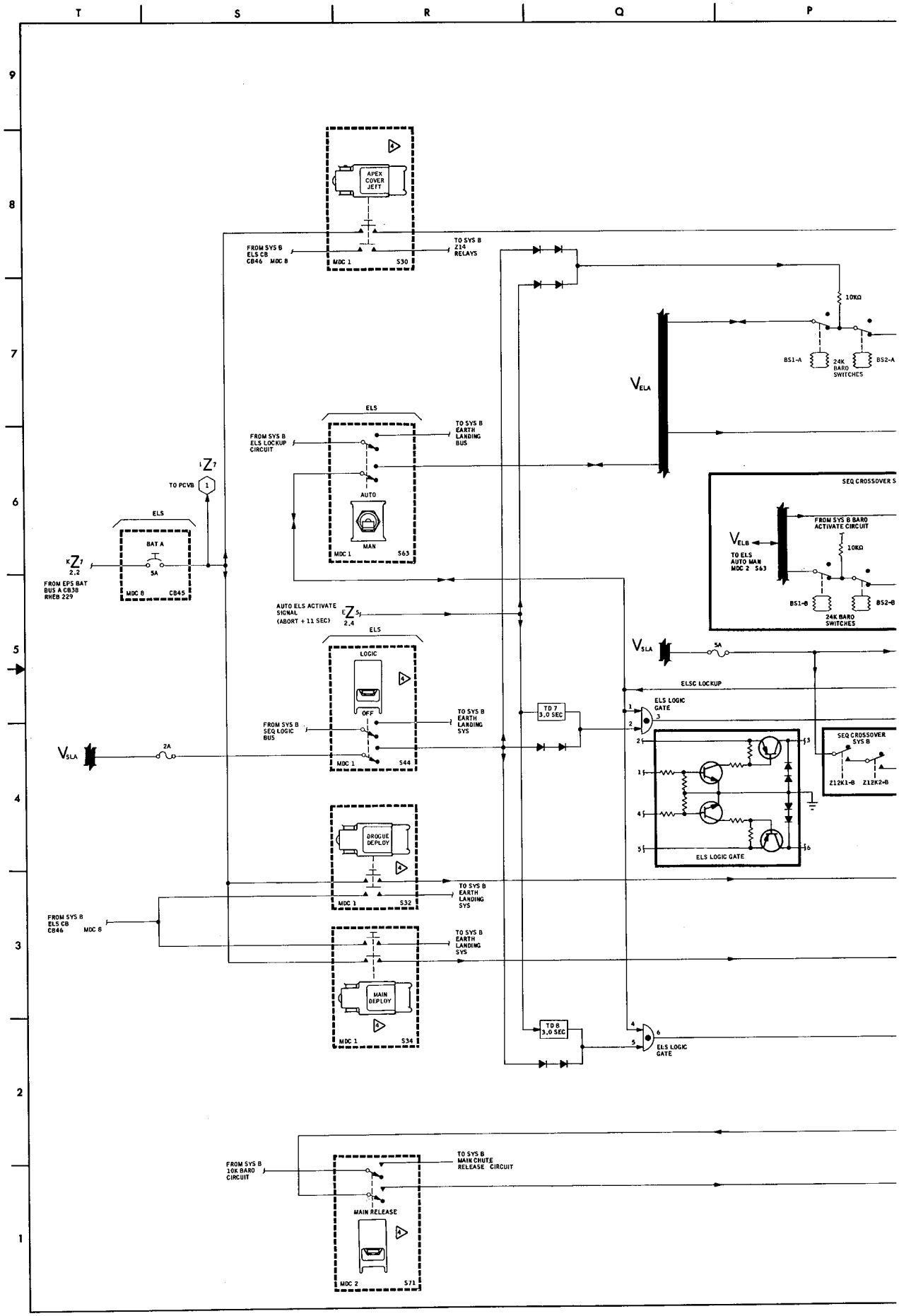
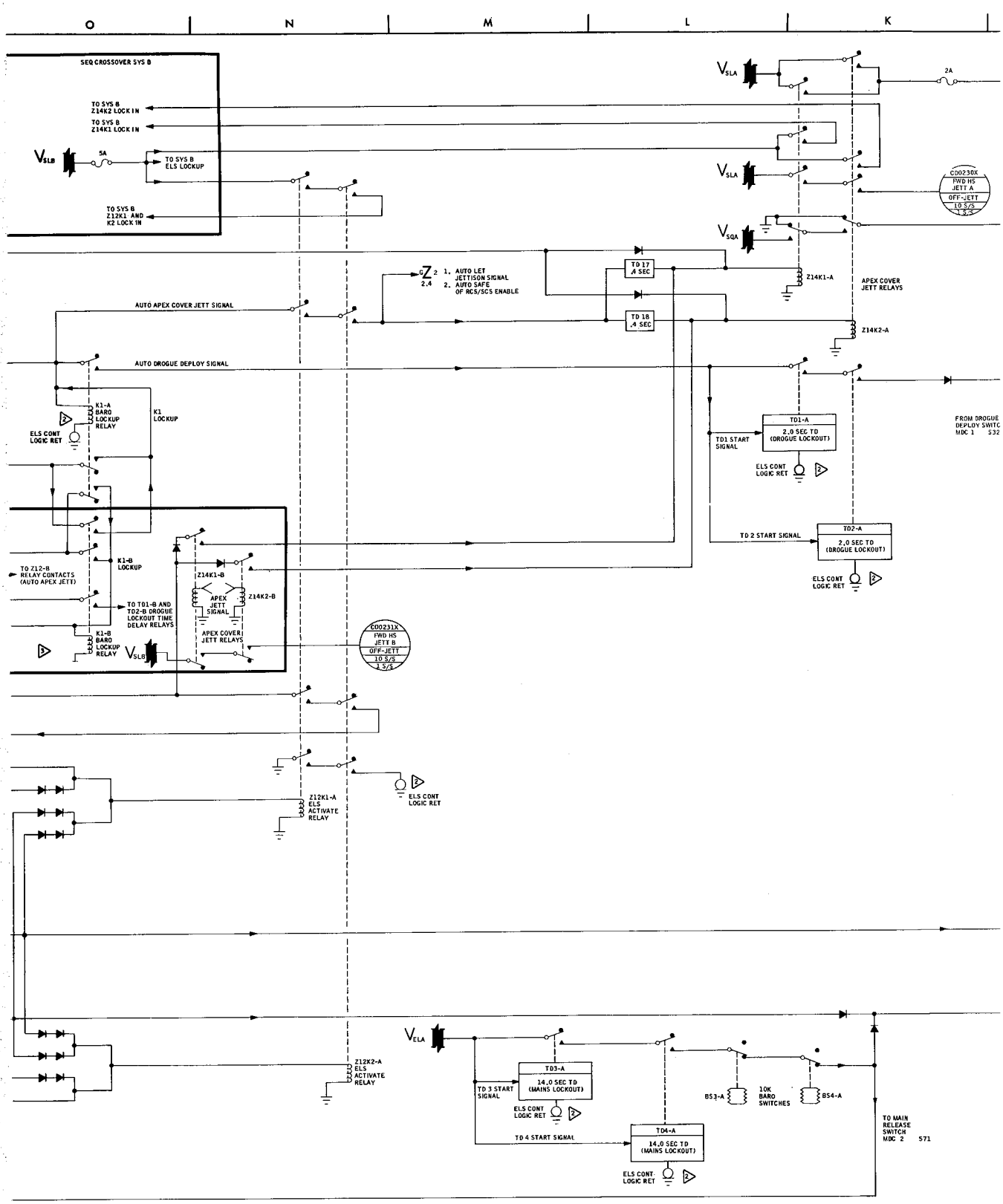
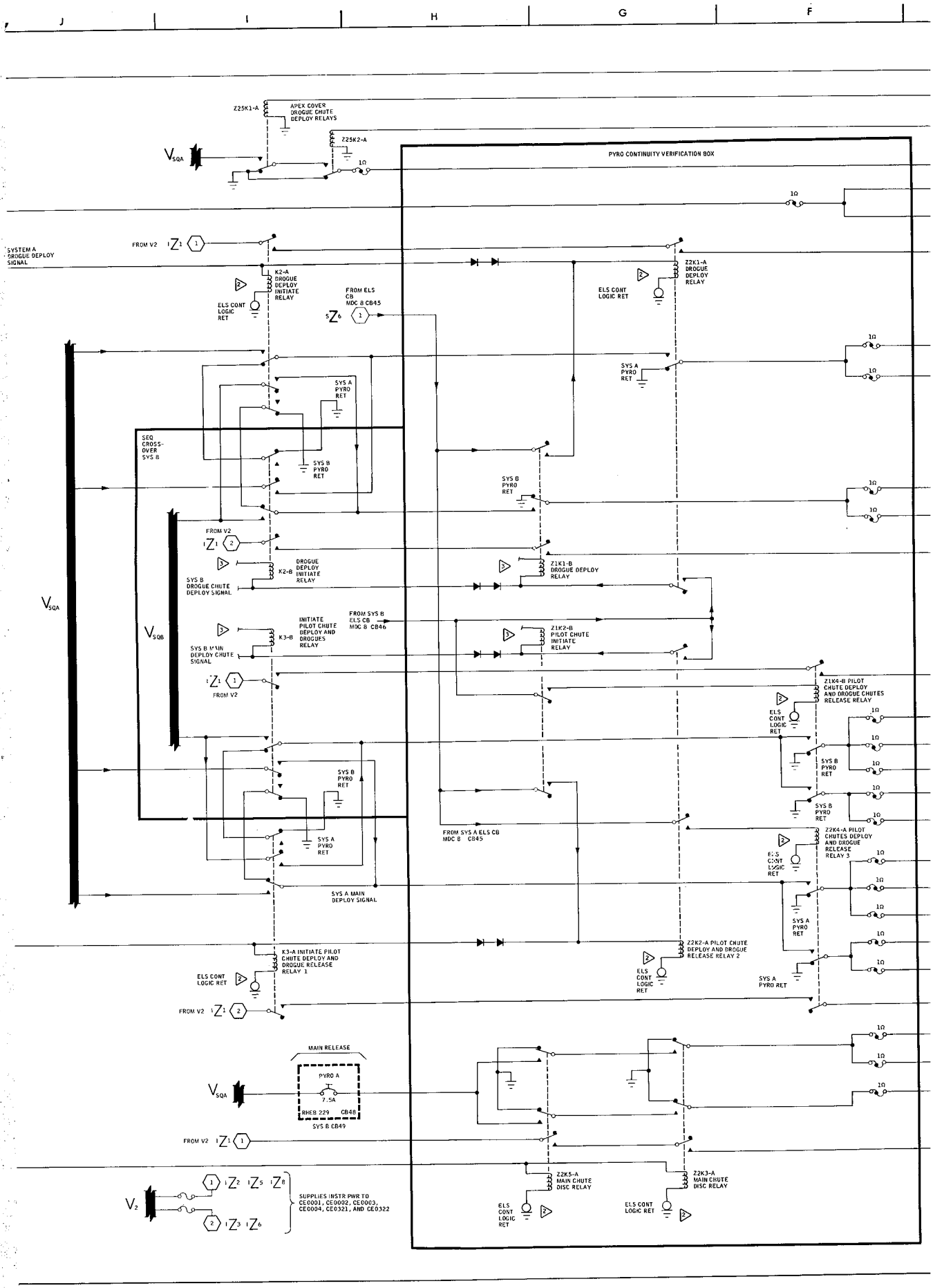
SEQUENTIAL LES AND SPS ABORT SUBSYSTEM

CSM	SIZE	DWG NO.
104	J	2.4

104,5X38,25 PAGE SHEET OF


T
S
R
Q
P
9
8
7
6
5
4
3
2
1
APEX COVER JETT
FROM SYS B ELS CB CB46 MDC 8
MDC 1
S30
TO SYS B Z14 RELAYS
10KΩ
BS1-A
24K BARO SWITCHES
BS2-A
VELA
ELS
FROM SYS B ELS LOCKUP CIRCUIT
TO SYS B EARTH LANDING BUS
AUTO
MAN
MDC 1
S63
SEQ CROSSOVER S
FROM SYS B BARO ACTIVATE CIRCUIT
VELB
TO ELS AUTO MAN MDC 2 S63
BS1-B
BS2-B
24K BARO SWITCHES
TO PCVB
ELS
BAT A
5A
MDC 8
CB45
FROM EPS BAT BUS A CB38 RHEB 229
AUTO ELS ACTIVATE SIGNAL (ABORT + 11 SEC)
ELS
LOGIC
OFF
FROM SYS B SEQ LOGIC BUS
TO SYS B EARTH LANDING SYS
MDC 1
S44
VSLA
2A
5A
ELSC LOCKUP
ELS LOGIC GATE
TD 7 3.0 SEC
SEQ CROSSOVER SYS B
Z12K1-B
Z12K2-B
DROGUE DEPLOY
MDC 1
S32
TO SYS B EARTH LANDING SYS
FROM SYS B ELS CB CB46 MDC 8
MAIN DEPLOY
MDC 1
S34
TD 8 3.0 SEC
ELS LOGIC GATE
FROM SYS B 10K BARO CIRCUIT
TO SYS B MAIN CHUTE RELEASE CIRCUIT
MAIN RELEASE
MDC 2
S71


O
N
M
L
K
SEQ CROSSOVER SYS B
TO SYS B Z14K2 LOCK IN
TO SYS B Z14K1 LOCK IN
V_{SLB}
5A
TO SYS B ELS LOCKUP
TO SYS B Z12K1 AND K2 LOCK IN
V_{SLA}
2A
C00230X FWD HS JETT A OFF-JETT 10 S/S 3 S/S
V_{SQA}
GZ 2.4
1. AUTO LET JETTISON SIGNAL
2. AUTO SAFE OF RCS/SCS ENABLE
TD 17 .4 SEC
TD 18 .4 SEC
Z14K1-A
APEX COVER JETT RELAYS
Z14K2-A
AUTO APEX COVER JETT SIGNAL
AUTO DROGUE DEPLOY SIGNAL
K1-A BARO LOCKUP RELAY
K1 LOCKUP
ELS CONT LOGIC RET
TD1-A
2.0 SEC TD (DROGUE LOCKOUT)
TD1 START SIGNAL
FROM DROGUE DEPLOY SWITC MDC 1 S32
TD2-A
2.0 SEC TD (DROGUE LOCKOUT)
TD 2 START SIGNAL
K1-B LOCKUP
TO Z12-B RELAY CONTACTS (AUTO APEX JETT)
TO TD1-B AND TD2-B DROGUE LOCKOUT TIME DELAY RELAYS
K1-B BARO LOCKUP RELAY
Z14K1-B
APEX JETT SIGNAL
Z14K2-B
APEX COVER JETT RELAYS
C00231X FWD HS JETT B OFF-JETT 10 S/S 3 S/S
Z12K1-A ELS ACTIVATE RELAY
Z12K2-A ELS ACTIVATE RELAY
V_{ELA}
TD3-A
14.0 SEC TD (MAINS LOCKOUT)
TD 3 START SIGNAL
TD4-A
14.0 SEC TD (MAINS LOCKOUT)
TD 4 START SIGNAL
BS3-A
10K BARO SWITCHES
BS4-A
TO MAIN RELEASE SWITCH MDC 2 S71


J
I
H
G
F
Z25K1-A
APEX COVER DROGUE CHUTE DEPLOY RELAYS
Z25K2-A
V_{SQA}
1Ω
PYRO CONTINUITY VERIFICATION BOX
SYSTEM A DROGUE DEPLOY SIGNAL
FROM V2
K2-A DROGUE DEPLOY INITIATE RELAY
ELS CONT LOGIC RET
FROM ELS CB MDC 8 CB45
Z2K1-A DROGUE DEPLOY RELAY
SYS A PYRO RET
SEQ CROSS-OVER SYS B
SYS B PYRO RET
V_{SQB}
K2-B DROGUE DEPLOY INITIATE RELAY
SYS B DROGUE CHUTE DEPLOY SIGNAL
Z1K1-B DROGUE DEPLOY RELAY
INITIATE PILOT CHUTE DEPLOY AND DROGUES RELAY
K3-B
SYS B MAIN DEPLOY CHUTE SIGNAL
FROM SYS B ELS CB MDC 8 CB46
Z1K2-B PILOT CHUTE INITIATE RELAY
Z1K4-B PILOT CHUTE DEPLOY AND DROGUE CHUTES RELEASE RELAY
SYS A MAIN DEPLOY SIGNAL
FROM SYS A ELS CB MDC 8 CB45
Z2K4-A PILOT CHUTES DEPLOY AND DROGUE RELEASE RELAY 3
K3-A INITIATE PILOT CHUTE DEPLOY AND DROGUE RELEASE RELAY 1
Z2K2-A PILOT CHUTE DEPLOY AND DROGUE RELEASE RELAY 2
MAIN RELEASE
PYRO A
7.5A
RHEB 229 CB48
SYS B CB49
Z2K5-A MAIN CHUTE DISC RELAY
Z2K3-A MAIN CHUTE DISC RELAY
V_2
SUPPLIES INSTR PWR TO CE0001, CE0002, CE0003, CE0004, CE0321, AND CE0322

LTR	DR	ENGR	DATE	APPROVAL

CM

FORWARD COMPARTMENT

APEX LANYARD (ACTIVATED BY PHYSICAL SEPARATION OF APEX COVER)

APEX COVER DRAG CHUTE INITIATOR

SYS A APEX JETTISON INITIATORS

SYS A PYRO RET

NO. 1
NO. 2
SYS A DROGUE CHUTES DEPLOY INITIATORS

SYS A PYRO RET

NO. 1
NO. 2
SYS B DROGUE CHUTES DEPLOY INITIATORS

SYS B PYRO RET

NO. 1
NO. 2
NO. 3
SYS B PILOT CHUTES DEPLOY INITIATORS

NO. 1
NO. 2
SYS B DROGUE CHUTES RELEASE INITIATORS

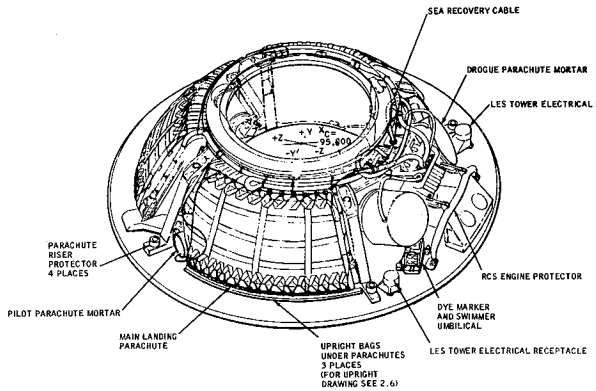
SYS B PYRO RET

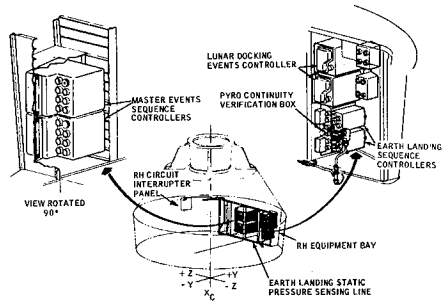
NO. 1
NO. 2
NO. 3
SYS A PILOT CHUTE DEPLOY INITIATORS

NO. 1
NO. 2
SYS A DROGUE CHUTES RELEASE INITIATORS

NO. 3
NO. 2
NO. 1
SYS A MAIN CHUTES RELEASE INITIATORS

SYS A PYRO RET





A SWITCH LOCATED UNDER PROTECTIVE COVER

B RELAYS WILL NOT BE GROUNDED UNTIL ELS ACTIVATED RELAYS Z12(SYS B) ARE ENERGIZED

C RELAYS WILL NOT BE GROUNDED UNTIL THE ELS ACTIVATE RELAYS Z12 (SYS A) ARE ENERGIZED

NOTES: 1 SYSTEM A SHOWN EXCEPT WHERE NOTED. PYRO VERIFICATION BOX SHOWN WITH SYSTEM A FUNCTIONS AND SYSTEM B CROSSOVERS SYSTEM B MAIN CHUTE RELEASE IDENTICAL TO SYSTEM A

5 EARTH LDG

SIGNATURES	DATE
DR Harvey Watt	
DSGN	
QC	11-6-68
ENGR	
NR	11-6-68
APP	11-6-68
FEC	11-7-68
AUTH	11-7-68

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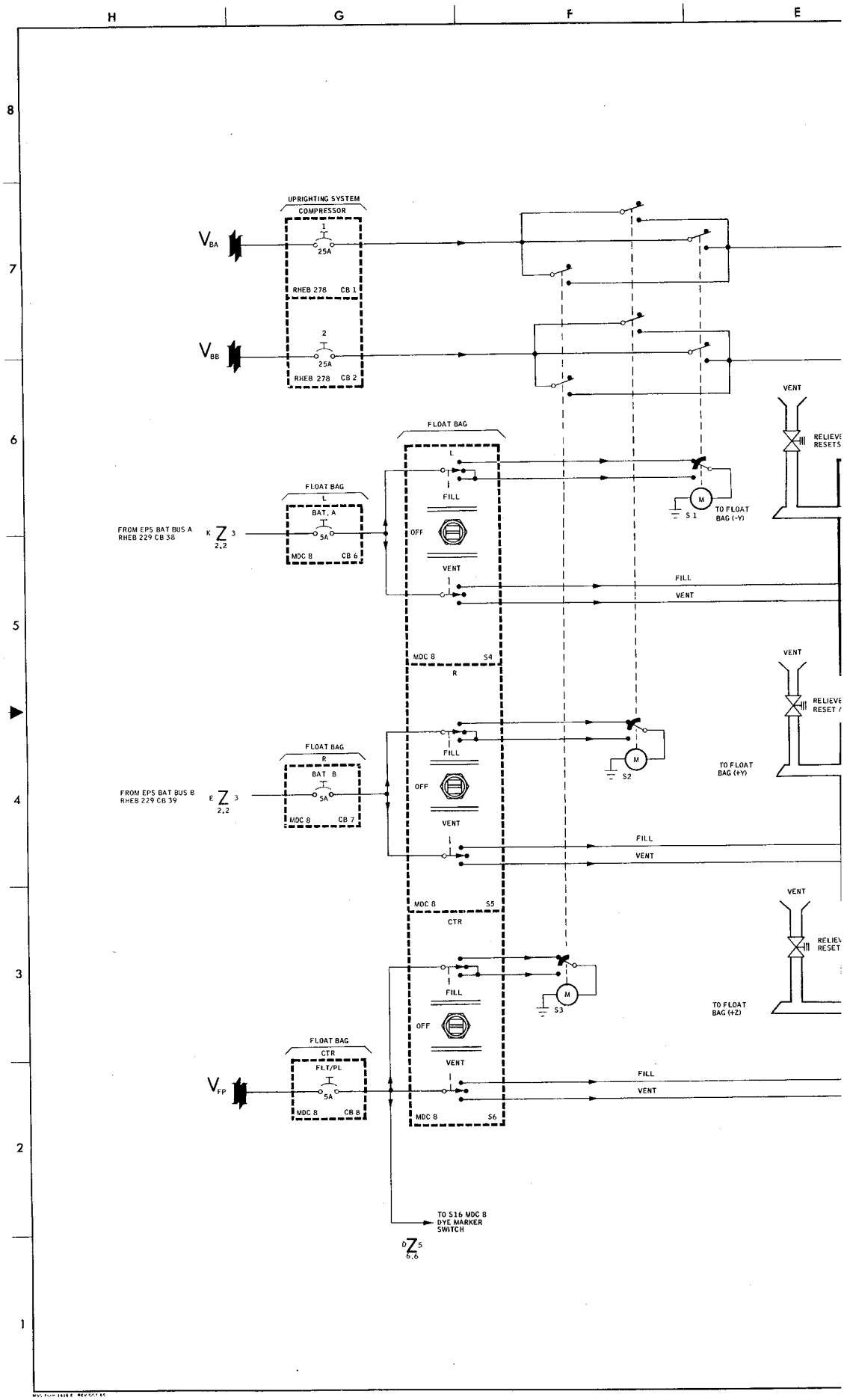
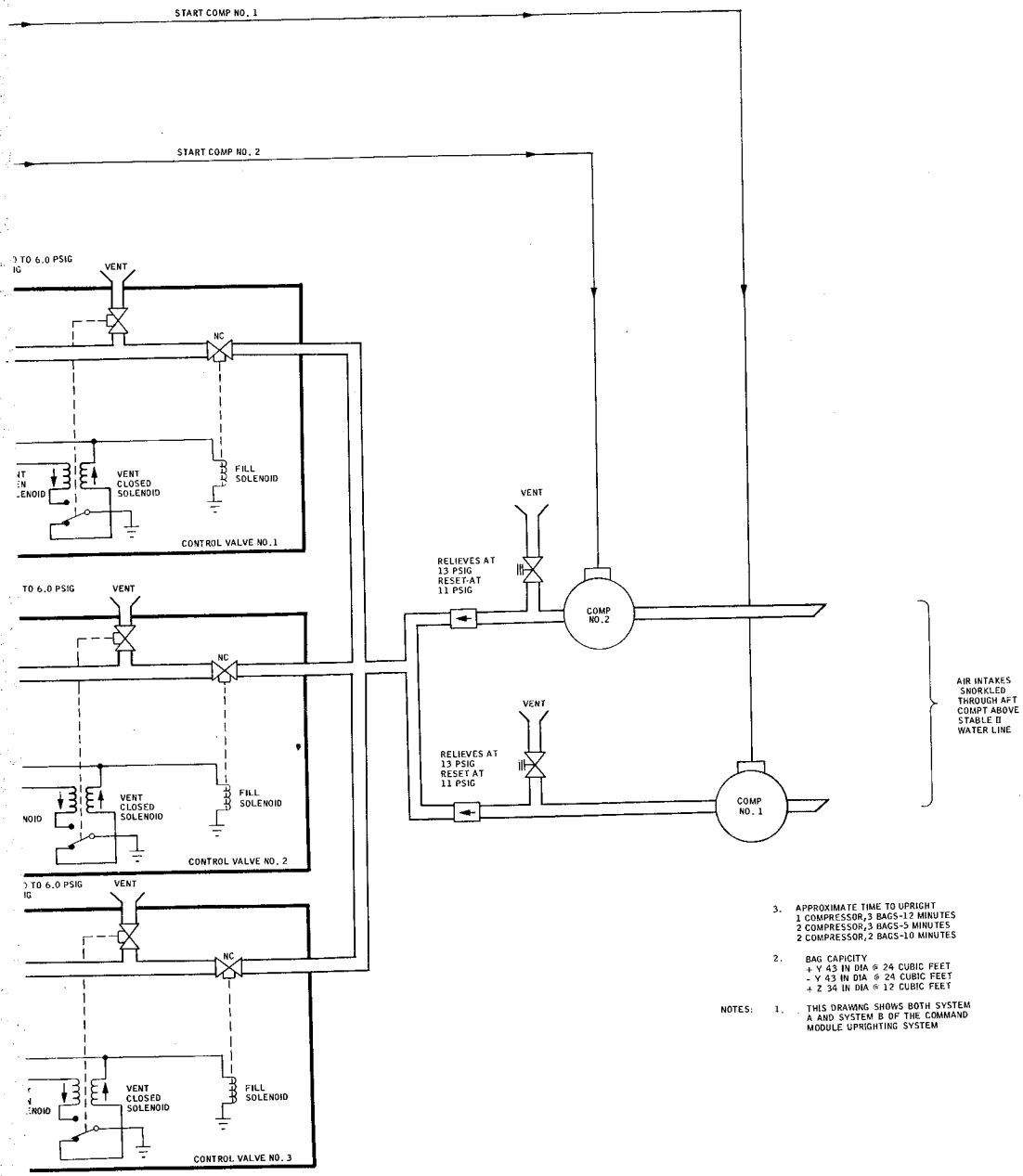
SEQUENTIAL EARTH LANDING SUBSYSTEM

CSM 104 | SIZE J | DWG NO. 2.5 | SHEET

110X38.25 PAGE


H
G
F
E
8
7
6
5
4
3
2
1
UPRIGHTING SYSTEM
COMPRESSOR
V_{BA}
1
25A
RHEB 278 CB 1
V_{BB}
2
25A
RHEB 278 CB 2
FLOAT BAG
L
FILL
OFF
VENT
MDC 8 S4
R
FLOAT BAG
L
BAT. A
5A
MDC 8 CB 6
FROM EPS BAT BUS A
RHEB 229 CB 38
K Z 3 2,2
FLOAT BAG
R
BAT B
5A
MDC 8 CB 7
FROM EPS BAT BUS B
RHEB 229 CB 39
E Z 3 2,2
MDC 8 S5
CTR
FLOAT BAG
CTR
FLT/PL
5A
MDC 8 CB 8
V_{FP}
MDC 8 S6
FILL
VENT
M
S1
S2
S3
TO FLOAT BAG (-Y)
TO FLOAT BAG (+Y)
TO FLOAT BAG (+Z)
VENT
RELIEVE
RESETS
TO S16 MDC 8
DYE MARKER
SWITCH
D Z 5 6,6

LTR	DR	ENGR	DATE	APPROVAL



3. APPROXIMATE TIME TO UPRIGHT
   1 COMPRESSOR, 3 BAGS-12 MINUTES
   2 COMPRESSOR, 3 BAGS-5 MINUTES
   2 COMPRESSOR, 2 BAGS-10 MINUTES

2. BAG CAPICITY
   + Y 43 IN DIA @ 24 CUBIC FEET
   - Y 43 IN DIA @ 24 CUBIC FEET
   + Z 34 IN DIA @ 12 CUBIC FEET

NOTES: 1. THIS DRAWING SHOWS BOTH SYSTEM A AND SYSTEM B OF THE COMMAND MODULE UPRIGHTING SYSTEM

6 UPRIGHTING

SIGNATURES	DATE
DR Allan Lewis	
DSGN	
QC A Taylor	11-8-68
ENGR [illegible]	11/1-68
NR [illegible]	11/1/68
APP [illegible]	10/27/68
FEC [illegible]	11/1/68
AUTH [illegible]	11-7-68

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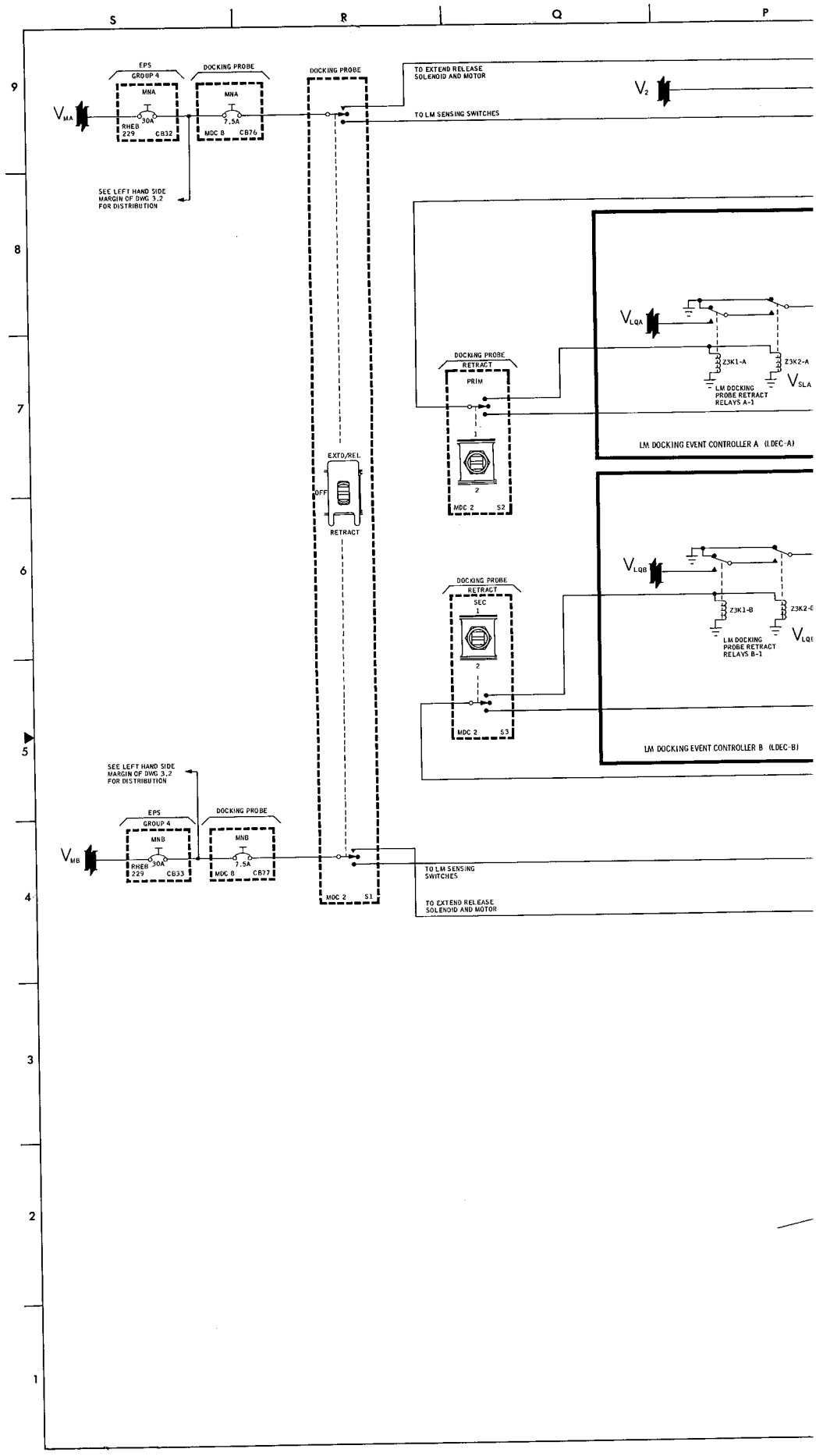
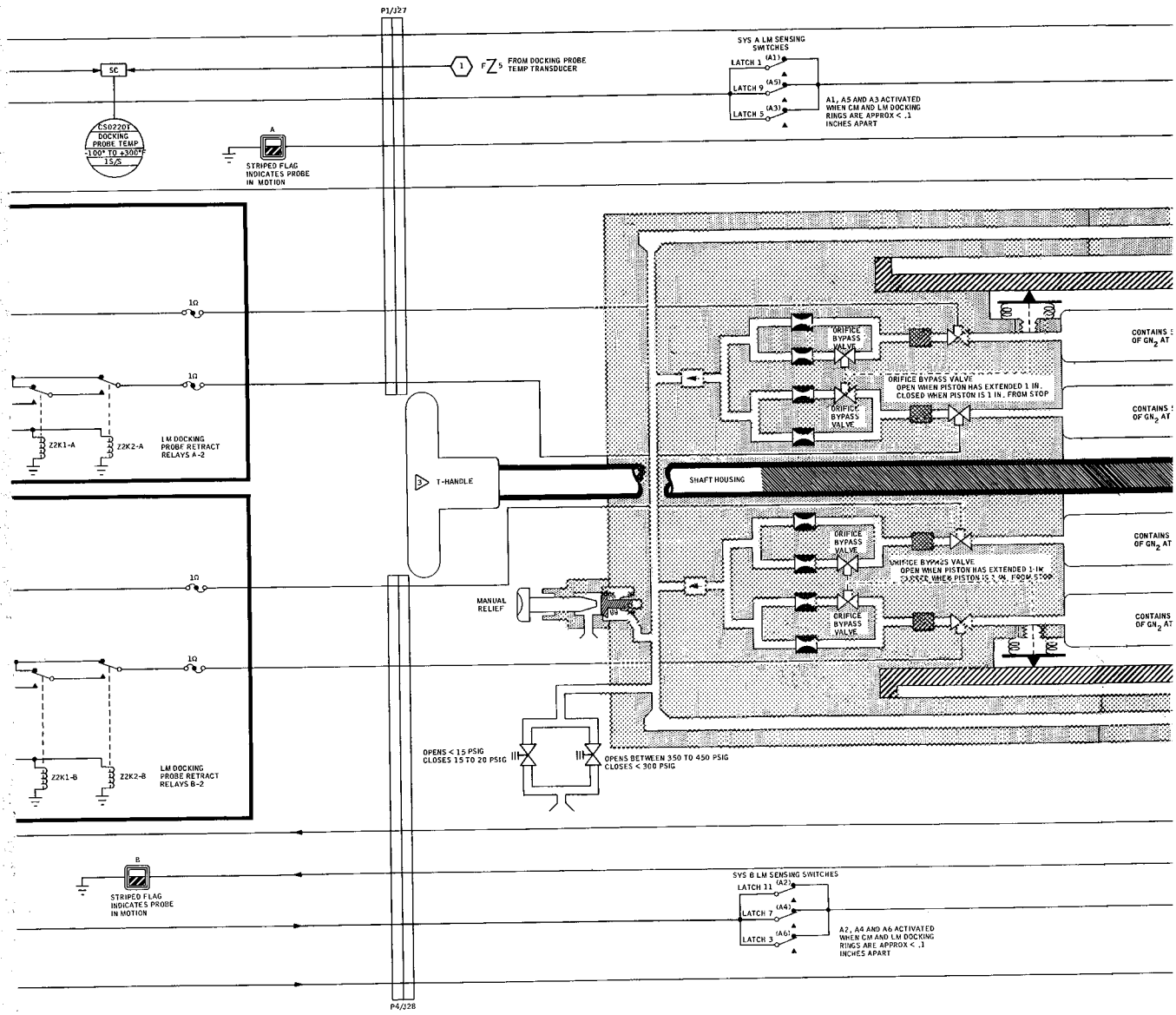
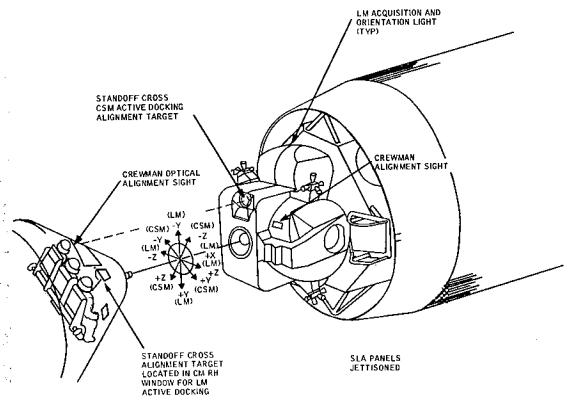
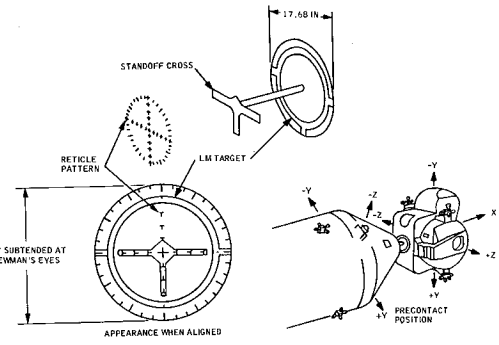
SEQUENTIAL UPRIGHTING SYSTEM

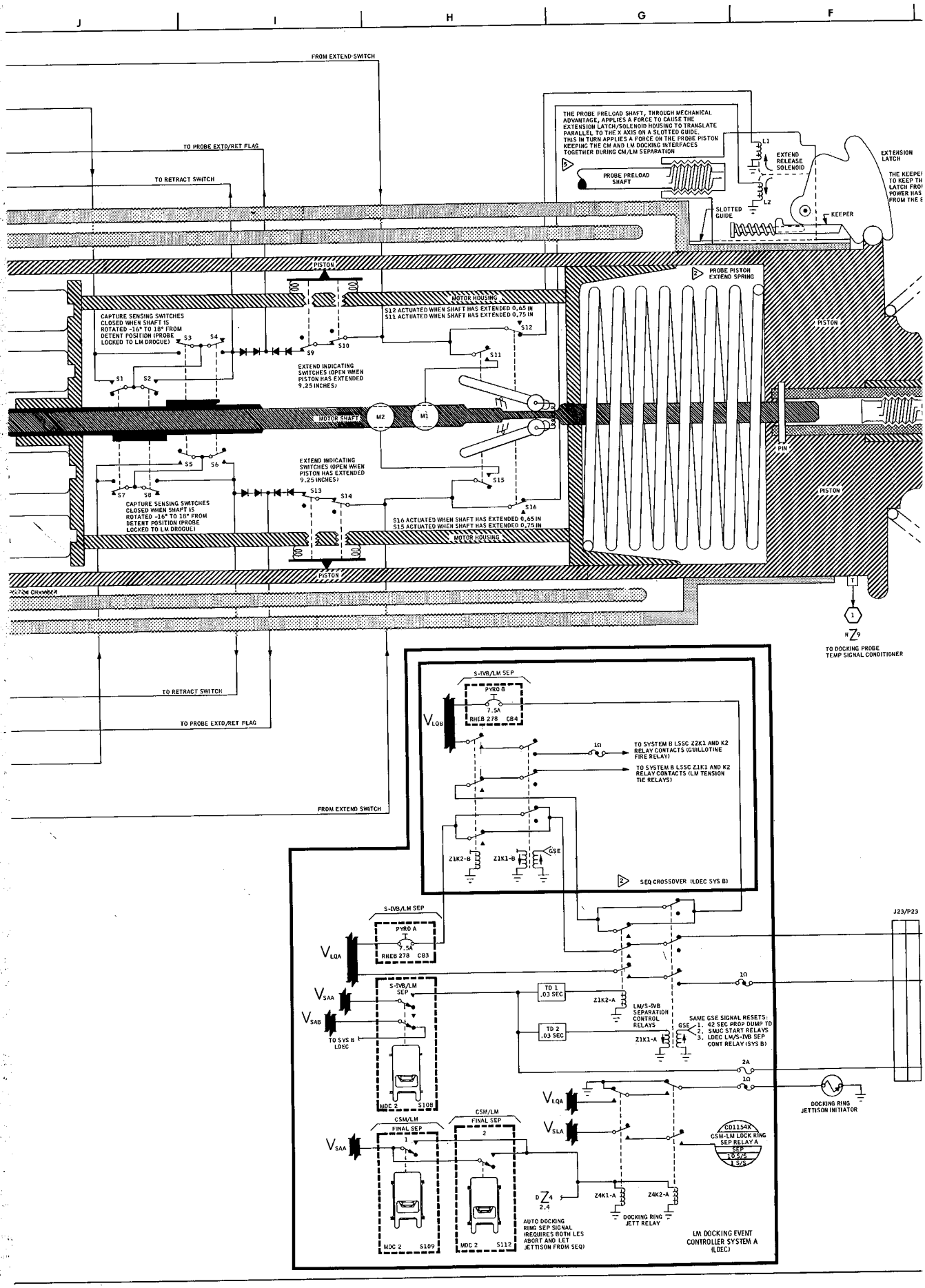
CSM	SIZE	DWG NO.
104	E	2.6
34 X 44	PAGE	SHEET 1 OF 1


S
R
Q
P
9
8
7
6
5
4
3
2
1
EPS
GROUP 4
MNA
30A
RHEB
229
C832
DOCKING PROBE
MNA
7.5A
MDC B
CB76
DOCKING PROBE
V_{MA}
TO EXTEND RELEASE SOLENOID AND MOTOR
TO LM SENSING SWITCHES
V_2
SEE LEFT HAND SIDE MARGIN OF DWG 3.2 FOR DISTRIBUTION
V_{LQA}
Z3K1-A
Z3K2-A
V_{SLA}
LM DOCKING PROBE RETRACT RELAYS A-1
DOCKING PROBE
RETRACT
PRIM
1
2
MDC 2
S2
LM DOCKING EVENT CONTROLLER A (LDEC-A)
EXTD/REL
OFF
RETRACT
V_{LQB}
Z3K1-B
Z3K2-B
V_{LQB}
LM DOCKING PROBE RETRACT RELAYS B-1
DOCKING PROBE
RETRACT
SEC
1
2
MDC 2
S3
LM DOCKING EVENT CONTROLLER B (LDEC-B)
SEE LEFT HAND SIDE MARGIN OF DWG 3.2 FOR DISTRIBUTION
EPS
GROUP 4
MNB
30A
RHEB
229
C833
DOCKING PROBE
MNB
7.5A
MDC B
CB77
V_{MB}
TO LM SENSING SWITCHES
TO EXTEND RELEASE SOLENOID AND MOTOR
MDC 2
S1

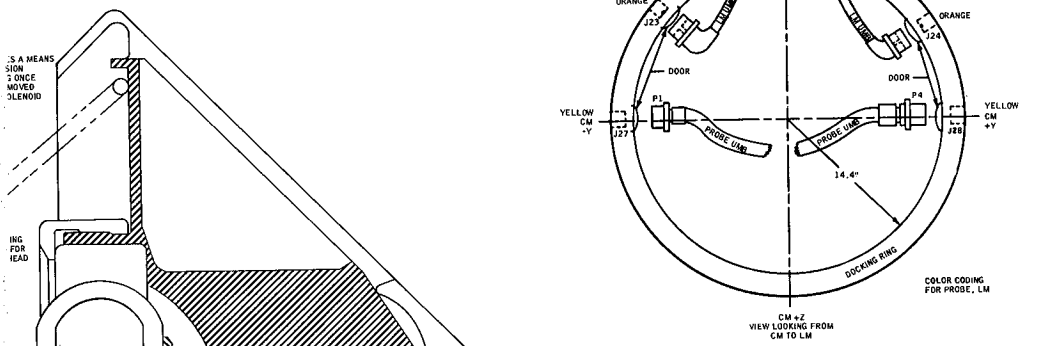

O
N
M
L
K
P1/J27
SC
ES0220T
DOCKING PROBE TEMP
-100° TO +300°F
1S/S
1
FZ5 FROM DOCKING PROBE TEMP TRANSDUCER
SYS A LM SENSING SWITCHES
LATCH 1
LATCH 9
LATCH 5
(A1)
(A5)
(A3)
A1, A5 AND A3 ACTIVATED WHEN CM AND LM DOCKING RINGS ARE APPROX < .1 INCHES APART
A
STRIPED FLAG INDICATES PROBE IN MOTION
1Ω
Z2K1-A
Z2K2-A
LM DOCKING PROBE RETRACT RELAYS A-2
3
T-HANDLE
SHAFT HOUSING
ORIFICE BYPASS VALVE
ORIFICE BYPASS VALVE OPEN WHEN PISTON HAS EXTENDED 1 IN. CLOSED WHEN PISTON IS 1 IN. FROM STOP
CONTAINS
OF GN2 AT
MANUAL RELIEF
OPENS < 15 PSIG
CLOSES 15 TO 20 PSIG
OPENS BETWEEN 350 TO 450 PSIG
CLOSES < 300 PSIG
Z2K1-B
Z2K2-B
LM DOCKING PROBE RETRACT RELAYS B-2
B
STRIPED FLAG INDICATES PROBE IN MOTION
SYS B LM SENSING SWITCHES
LATCH 11
LATCH 7
LATCH 3
(A2)
(A4)
(A6)
A2, A4 AND A6 ACTIVATED WHEN CM AND LM DOCKING RINGS ARE APPROX < .1 INCHES APART
P4/J28

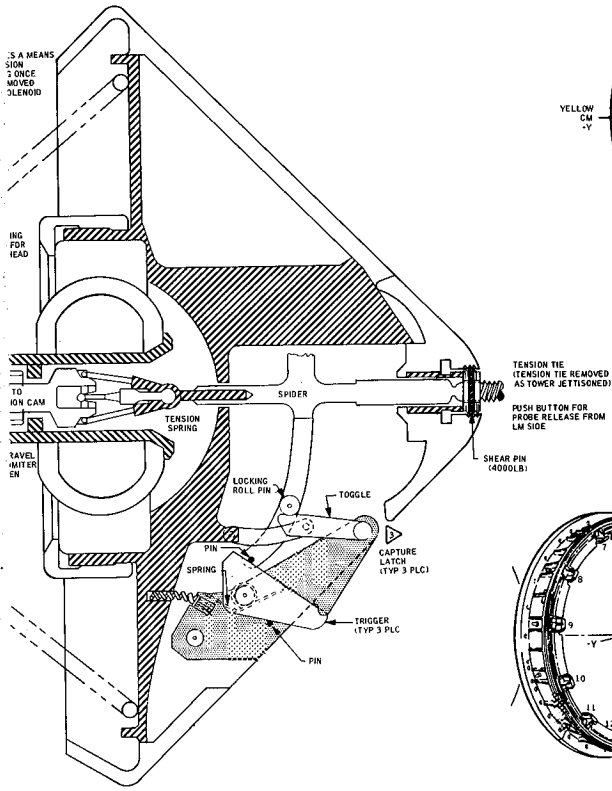

LM ACQUISITION AND ORIENTATION LIGHT (TYP)
STANDOFF CROSS CSM ACTIVE DOCKING ALIGNMENT TARGET
CREWMAN OPTICAL ALIGNMENT SIGHT
CREWMAN ALIGNMENT SIGHT
STANDOFF CROSS ALIGNMENT TARGET LOCATED IN CM RH WINDOW FOR LM ACTIVE DOCKING
SLA PANELS JETTISONED

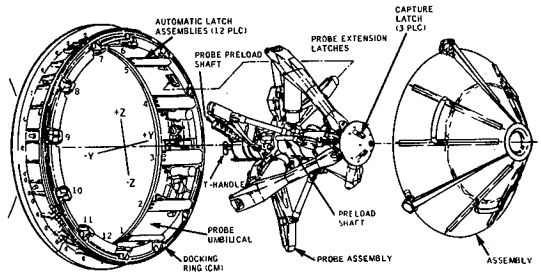

17.68 IN.
STANDOFF CROSS
RETICLE PATTERN
LM TARGET
10° SUBTENDED AT CREWMAN'S EYES
APPEARANCE WHEN ALIGNED
PRECONTACT POSITION

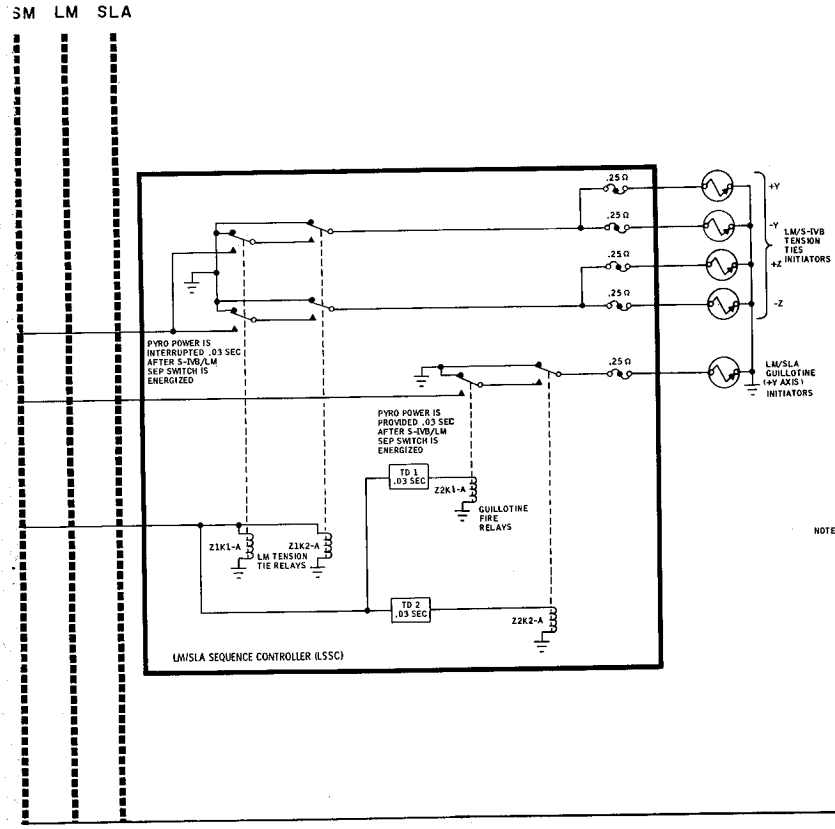

J
I
H
G
F
FROM EXTEND SWITCH
TO PROBE EXTD/RET FLAG
TO RETRACT SWITCH
THE PROBE PRELOAD SHAFT, THROUGH MECHANICAL ADVANTAGE, APPLIES A FORCE TO CAUSE THE EXTENSION LATCH/SOLENOID HOUSING TO TRANSLATE PARALLEL TO THE X AXIS ON A SLOTTED GUIDE. THIS IN TURN APPLIES A FORCE ON THE PROBE PISTON KEEPING THE CM AND LM DOCKING INTERFACES TOGETHER DURING CM/LM SEPARATION
PROBE PRELOAD SHAFT
EXTEND RELEASE SOLENOID
L1
L2
EXTENSION LATCH
SLOTTED GUIDE
KEEPER
PISTON
MOTOR HOUSING
PROBE PISTON EXTEND SPRING
CAPTURE SENSING SWITCHES CLOSED WHEN SHAFT IS ROTATED -16° TO 18° FROM DETENT POSITION (PROBE LOCKED TO LM DROGUE)
S1
S2
S3
S4
S9
S10
S12 ACTUATED WHEN SHAFT HAS EXTENDED 0.65 IN
S11 ACTUATED WHEN SHAFT HAS EXTENDED 0.75 IN
S11
S12
EXTEND INDICATING SWITCHES (OPEN WHEN PISTON HAS EXTENDED 9.25 INCHES)
MOTOR SHAFT
M2
M1
PIN
EXTEND INDICATING SWITCHES (OPEN WHEN PISTON HAS EXTENDED 9.25 INCHES)
S5
S6
S7
S8
S13
S14
S15
S16
CAPTURE SENSING SWITCHES CLOSED WHEN SHAFT IS ROTATED -16° TO 18° FROM DETENT POSITION (PROBE LOCKED TO LM DROGUE)
S16 ACTUATED WHEN SHAFT HAS EXTENDED 0.65 IN
S15 ACTUATED WHEN SHAFT HAS EXTENDED 0.75 IN
TO DOCKING PROBE TEMP SIGNAL CONDITIONER
S-IVB/LM SEP
PYRO B
7.5A
RHEB 278 CB4
V_{LQB}
1Ω
TO SYSTEM B LSSC Z2K1 AND K2 RELAY CONTACTS (GUILLOTINE FIRE RELAY)
TO SYSTEM B LSSC Z1K1 AND K2 RELAY CONTACTS (LM TENSION TIE RELAYS)
Z1K2-B
Z1K1-B
GSE
SEQ CROSSOVER (LDEC SYS B)
S-IVB/LM SEP
PYRO A
7.5A
RHEB 278 CB3
V_{LQA}
V_{SAA}
V_{SAB}
S-IVB/LM SEP
TO SYS B LDEC
MDC 2 S108
TO 1 .03 SEC
TO 2 .03 SEC
Z1K2-A
Z1K1-A
LM/S-IVB SEPARATION CONTROL RELAYS
SAME GSE SIGNAL RESETS:
1. 42 SEC PROP DUMP TD
2. SM/C START RELAYS
3. LDEC LM/S-IVB SEP CONT RELAY (SYS B)
J23/P23
2A
1Ω
DOCKING RING JETTISON INITIATOR
CSM/LM FINAL SEP
CSM/LM FINAL SEP 2
V_{SAA}
V_{LQA}
V_{SLA}
MDC 2 S109
MDC 2 S112
CDI154X
CSM-LM LOCK RING SEP RELAY A
SEP
10 S/S
1 S/S
Z4K1-A
Z4K2-A
DOCKING RING JETT RELAY
AUTO DOCKING RING SEP SIGNAL (REQUIRES BOTH LES ABORT AND LET JETTISON FROM SEQ)
LM DOCKING EVENT CONTROLLER SYSTEM A (LDEC)

LTR	DR	ENGR	DATE	APPROVAL









6 FOR LOCATION AND ELECTRIC CONTROL OF LIGHT AND TARGET SEE LIGHTING DRAWING IN SECTION 11.

5 CSM/LM SEPARATION IS ACCOMPLISHED BY THE CREW APPLYING A PRELOAD ON THE EXTENSION SHAFT BY MEANS OF A PERMANENTLY INSTALLED TORQUE PRELOAD HANDLE. WHEN A PRELOAD HAS BEEN APPLIED AT THE INTERFACE, THE CREW WILL MANUALLY RELEASE AND COCK THE 12 AUTOMATIC DOCKING LATCHES. AFTER THE FORWARD PRESSURE HATCH HAS BEEN INSTALLED, THE CREW WILL PLACE THE EXTD/REL-RETRACT SWITCH (MDC 2) TO THE EXTD/REL POSITION. THIS WILL EXTEND THE PROBE AND UNLOCK THE CAPTURE LATCHES.

4 ORIFICE BYPASS VALVE
DURING THE LAST ONE INCH OF THE RETRACT CYCLE, THE ORIFICE BYPASS VALVE WILL BE OPEN ALLOWING THE PRESSURE CHAMBER TO BUILD UP TO 250 PSIG.

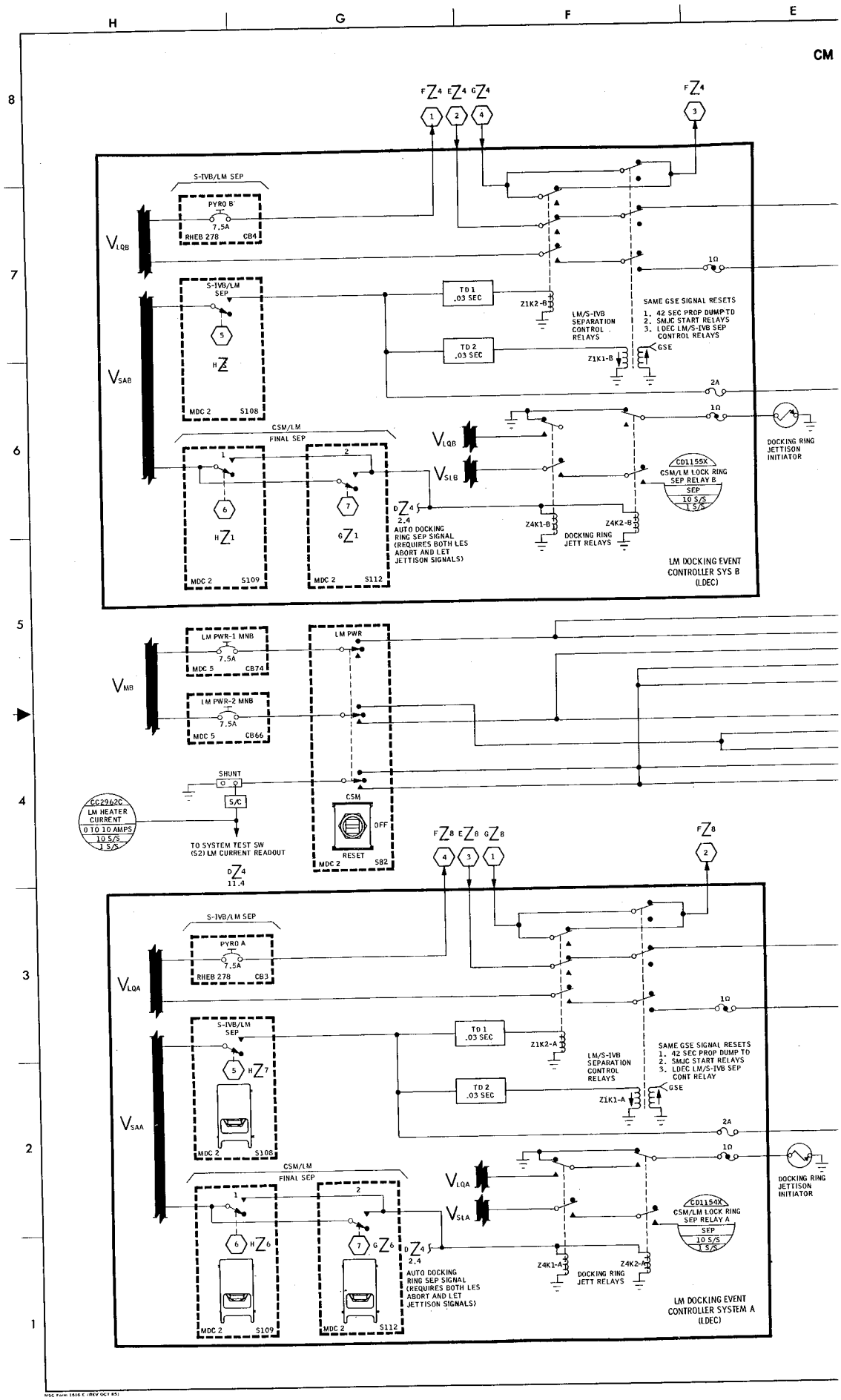
3 CAPTURE LATCHES/MOTOR SHAFT
A. THE CAPTURE LATCHES ARE UNLOCKED BY THE MOTOR ROTATING THE MOTOR SHAFT 150° CLOCKWISE WHEN THE EXTD/REL RETRACT SWITCH (S1 MDC 2) IS PLACED IN THE EXTD/REL POSITION.
(1) THE MOTOR SHAFT APPLIES A TORQUING MOMENT TO THE ROTATION TO TRANSLATION CAM. THE ROTATION TO TRANSLATION CAM IN TURN APPLIES A TENSION FORCE TO THE TENSION SPRING, PULLING THE SPIDER DOWN AND ALLOWING THE LOCKING PIN TO ENGAGE THE TOGGLE.
(2) THE MOTOR SHAFT IS LOCKED IN THIS POSITION (150° CLOCKWISE) BY THE LOCKING PIN (PREVENTS THE TENSION SPRING FROM ROTATING THE SHAFT COUNTERCLOCKWISE), UNTIL THE PROBE HEAD AND LM DROGUE MAKE PHYSICAL CONTACT (CAPTURE).
(3) AN INDICATION THAT THIS HAS OCCURRED IS THE PROBE EXTD/RET A AND B FLAGS ON MDC 2 WILL CHANGE FROM GRAY TO BARBER AND THEN BACK TO GRAY WHEN THE PROBE HAS EXTENDED TEN INCHES.
B. WHEN THE PROBE HEAD AND LM DROGUE MAKE CONTACT, THE THREE CAPTURE LATCHES, THROUGH MECHANICAL ACTION, RELEASE THE LOCKING PIN WHICH IS HOLDING THE SPIDER DOWN, AND ALLOWS THE TENSION SPRING TO DRIVE THE SHAFT APPROXIMATELY 165° COUNTERCLOCKWISE.
(1) AN INDICATION THAT THIS HAS OCCURRED IS THE PROBE EXTR/RET A AND B FLAGS ON MDC 2 CHANGE FROM GRAY TO BARBER POLE.
(2) IF THE EXTD/REL RETRACT SWITCH (S1 MDC 2) HAS PREVIOUSLY BEEN PLACED IN THE RETRACT POSITION AN AUTOMATIC GAS RETRACTION WILL OCCUR IF THE DOCKING PROBE - RETRACT PRIM OR SEC SWITCHES (MDC 2 S2 AND S3) HAVE BEEN PLACED TO AN UNUSED BOTTLE POSITION.
C. THE SHAFT IS RETURNED TO ITS INITIAL 150° FROM DETENT WHEN THE CREW ROTATES THE T-HANDLE CLOCKWISE TO REMOVE THE PROBE (UNLOCKS THE CAPTURE LATCHES)

2 THE PROBE PISTON SPRING ACTS AS A PRELOAD TO EXTEND THE PROBE ONCE THE PROBE EXTEND LATCH RELEASE SOLENOID HAS BEEN ENERGIZED. THE PROBE EXTENSION LATCH IS ENERGIZED BY PLACING THE EXTD/REL - RETRACT SWITCH (MDC 2, S1), TO THE EXTD/REL POSITION. IN A RETRACT POSITION, THE PROBE PISTON EXERTS A FORCE OF 130 LBS ON THE PROBE ASSEMBLY AND 70 LBS WHEN EXTENDED 10 INCHES.

NOTES: 1 SYSTEM A AND B OF THE DOCKING PROBE AND RELATED ELECTRONIC COMPONENTS SHOWN.

5 DOCKING

SIGNATURES	DATE	NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER · HOUSTON, TEXAS
DR Ch. J. Dalby		
DSGN		
QC		
ENGR J. Kelly	9/1/62	DOCKING PROBE
NR	11/1/62	
APP	12-26-62	
FEC	11/1/62	CSM 104 · SIZE J · DWG NO 2.7
AUTH	11-26-62	104.5 X 38.25 · PAGE · SHEET OF

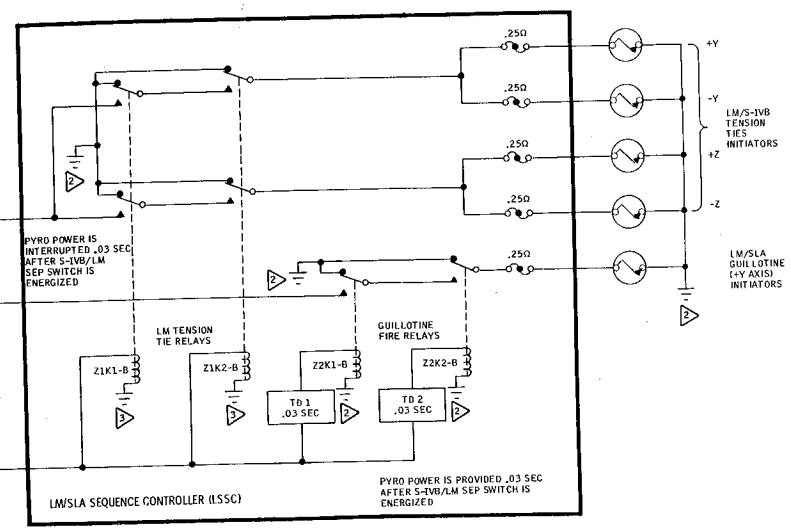

CM
S-IVB/LM SEP
PYRO B
7.5A
RHEB 278
CB4
V_{LQB}
V_{SAB}
S-IVB/LM SEP
MDC 2
S108
TD 1
.03 SEC
TD 2
.03 SEC
Z1K2-B
Z1K1-B
LM/S-IVB SEPARATION CONTROL RELAYS
SAME GSE SIGNAL RESETS
1. 42 SEC PROP DUMP TD
2. SMJC START RELAYS
3. LDEC LM/S-IVB SEP CONTROL RELAYS
GSE
1Ω
2A
DOCKING RING JETTISON INITIATOR
CSM/LM FINAL SEP
MDC 2
S109
MDC 2
S112
V_{LQB}
V_{SLB}
CD1155X
CSM/LM LOCK RING SEP RELAY B
SEP
10 S/S
1 S/S
Z4K1-B
Z4K2-B
DOCKING RING JETT RELAYS
AUTO DOCKING RING SEP SIGNAL (REQUIRES BOTH LES ABORT AND LET JETTISON SIGNALS)
LM DOCKING EVENT CONTROLLER SYS B (LDEC)
LM PWR-1 MNB
7.5A
MDC 5
CB74
LM PWR-2 MNB
7.5A
MDC 5
CB66
V_{MB}
LM PWR
SHUNT
S/C
CC2962C
LM HEATER CURRENT
0 TO 10 AMPS
10 S/S
1 S/S
TO SYSTEM TEST SW (S2) LM CURRENT READOUT
CSM
OFF
RESET
MDC 2
S82
S-IVB/LM SEP
PYRO A
7.5A
RHEB 278
CB3
V_{LQA}
V_{SAA}
S-IVB/LM SEP
MDC 2
S108
TD 1
.03 SEC
TD 2
.03 SEC
Z1K2-A
Z1K1-A
LM/S-IVB SEPARATION CONTROL RELAYS
SAME GSE SIGNAL RESETS
1. 42 SEC PROP DUMP TD
2. SMJC START RELAYS
3. LDEC LM/S-IVB SEP CONT RELAY
GSE
1Ω
2A
DOCKING RING JETTISON INITIATOR
CSM/LM FINAL SEP
MDC 2
S109
MDC 2
S112
V_{LQA}
V_{SLA}
CD1154X
CSM/LM LOCK RING SEP RELAY A
SEP
10 S/S
1 S/S
Z4K1-A
Z4K2-A
DOCKING RING JETT RELAYS
AUTO DOCKING RING SEP SIGNAL (REQUIRES BOTH LES ABORT AND LET JETTISON SIGNALS)
LM DOCKING EVENT CONTROLLER SYSTEM A (LDEC)

LTR	ZONE	REVISION	DATE	APPROVAL

TUNNEL / UMBILICAL | LM | SLA

J24/P24 J9/P9

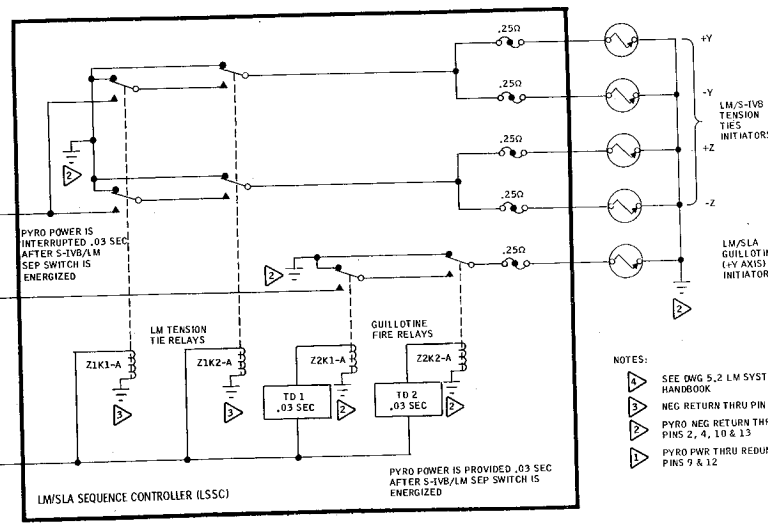
J23/P23 J10/P10



14 14 TO DES BAT RESET COILS
15 15 TO V_{CDR} AND CNTL ASSY NO 2
16 16 TO LV DES SET COILS
8 8 TO LMP XLUNAR BUS, AND 4CB5
7 7

16 16 TO LV DES SET COILS
15 15 TO V_{CDR} AND CNTL ASSY NO 2
14 14
8 8 TO RELAYS 4K3 AND 4K4, CDR XLUNAR BUS, AND 4CB4
7 7

3 3
1 1
5 5



NOTES:
4. SEE DWG 5.2 LM SYSTEMS HANDBOOK
3. NEG RETURN THRU PIN 6
2. PYRO NEG RETURN THRU PINS 2, 4, 10 & 13
1. PYRO PWR THRU REDUNDANT PINS 9 & 12

8 LM INTER

SIGNATURES	DATE
DR SF	
ENG C.M. Jones	11/1/68
CH	
NR	11/1/68
APP	11/1/68
AUTH	
Dickinson, ITT/GCD 11/7/68	
Don Young 11-7-68	

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS

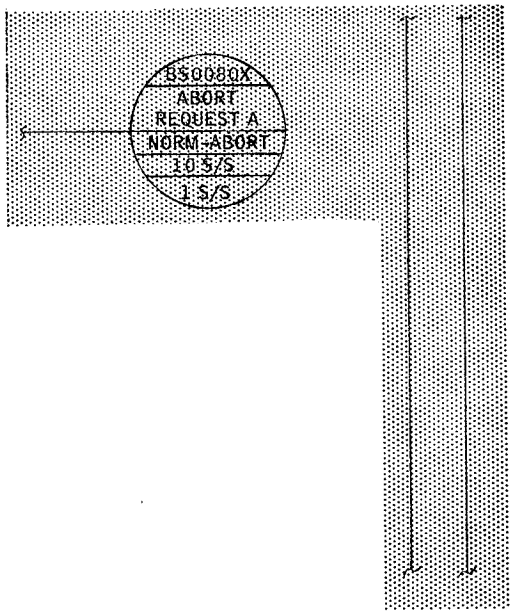
CSM–LM ELECTRICAL INTERFACE

CSM	SIZE	DWG NO.
104	E	2.8
34 X 44		SHEET

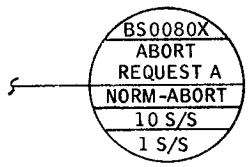
SECTION 2

IS

1. DWG 2.3 J Z 5



WAS



THE ABORT REQUEST LIGHT AND ASSOCIATED TELEMETRY (BS0080 & BS0081) WILL BECOME LOGIC "1" (ON) WHENEVER S/C BECO IS COMMANDED. THE LIGHT WILL THEN BECOME LOGIC "0" (OFF) WHENEVER THC IS RETURNED TO NEUTRAL OR SEPARATION OCCURS

SECTION 2

1. DWG 2.7 B,A Z 4,3

IS

3 CAPTURE LATCHES/MOTOR SHAFT

A. THE CAPTURE LATCHES ARE UNLOCKED BY THE MOTOR ROTATING THE MOTOR SHAFT 180° CLOCKWISE WHEN THE EXTD/REL RETRACT SWITCH (S1 MDC 2) IS PLACED IN THE EXTD/REL POSITION.

(1) THE MOTOR SHAFT APPLIES A TORQUING MOMENT TO THE ROTATION TO TRANSLATION CAM. THE ROTATION TO TRANSLATION CAM IN TURN APPLIES A TENSION FORCE TO THE TENSION SPRING, PULLING THE SPIDER DOWN AND ALLOWING THE LOCKING PIN TO ENGAGE THE TOGGLE.

(2) THE MOTOR SHAFT IS KEPT FROM ROTATING BACK TO 0° BY THE LOCKING PIN, UNTIL THE PROBE HEAD AND LM DROGUE MAKE PHYSICAL CONTACT (CAPTURE).

(3) AN INDICATION THAT THIS HAS OCCURRED IS THE PROBE EXTD/RET A AND B FLAGS ON MDC 2 WILL CHANGE FROM GRAY TO BARBER AND THEN BACK TO GRAY WHEN THE PROBE HAS EXTENDED TEN INCHES

B. WHEN THE PROBE HEAD AND LM DROGUE MAKE CONTACT, THE THREE CAPTURE LATCHES, THROUGH MECHANICAL ACTION, RELEASE THE LOCKING PIN WHICH IS HOLDING THE SPIDER DOWN, AND ALLOWS THE TENSION SPRING TO DRIVE THE SHAFT BACK TO 0°.

WAS

3 CAPTURE LATCHES/MOTOR SHAFT

A. THE CAPTURE LATCHES ARE UNLOCKED BY THE MOTOR ROTATING THE MOTOR SHAFT 150° CLOCKWISE WHEN THE EXTD/REL RETRACT SWITCH (S1 MDC 2) IS PLACED IN THE EXTD/REL POSITION.

(1) THE MOTOR SHAFT APPLIES A TORQUING MOMENT TO THE ROTATION TO TRANSLATION CAM. THE ROTATION TO TRANSLATION CAM IN TURN APPLIES A TENSION FORCE TO THE TENSION SPRING, PULLING THE SPIDER DOWN AND ALLOWING THE LOCKING PIN TO ENGAGE THE TOGGLE.

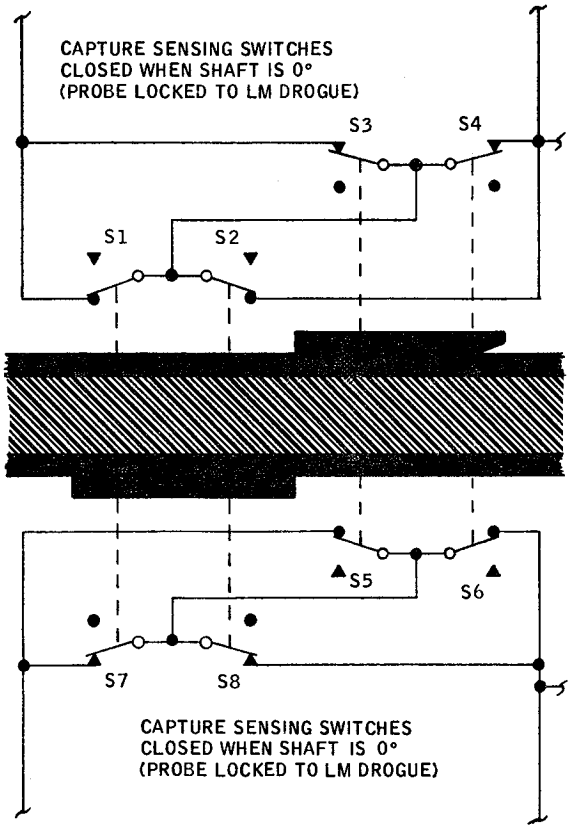
(2) THE MOTOR SHAFT IS LOCKED IN THIS POSITION (150° CLOCKWISE) BY THE LOCKING PIN (PREVENTS THE TENSION SPRING FROM ROTATING THE SHAFT COUNTERCLOCKWISE), UNTIL THE PROBE HEAD AND LM DROGUE MAKE PHYSICAL CONTACT

(3) AN INDICATION THAT THIS HAS OCCURRED IS THE PROBE EXTD/RET A AND B FLAGS ON MDC 2 WILL CHANGE FROM GRAY TO BARBER AND THEN BACK TO GRAY WHEN THE PROBE HAS EXTENDED TEN INCHES

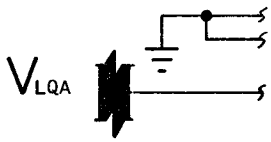
B. WHEN THE PROBE HEAD AND LM DROGUE MAKE CONTACT, THE THREE CAPTURE LATCHES, THROUGH MECHANICAL ACTION, RELEASE THE LOCKING PIN WHICH IS HOLDING THE SPIDER DOWN, AND ALLOWS THE TENSION SPRING TO DRIVE THE SHAFT APPROXIMATELY 165° COUNTERCLOCKWISE.

IS

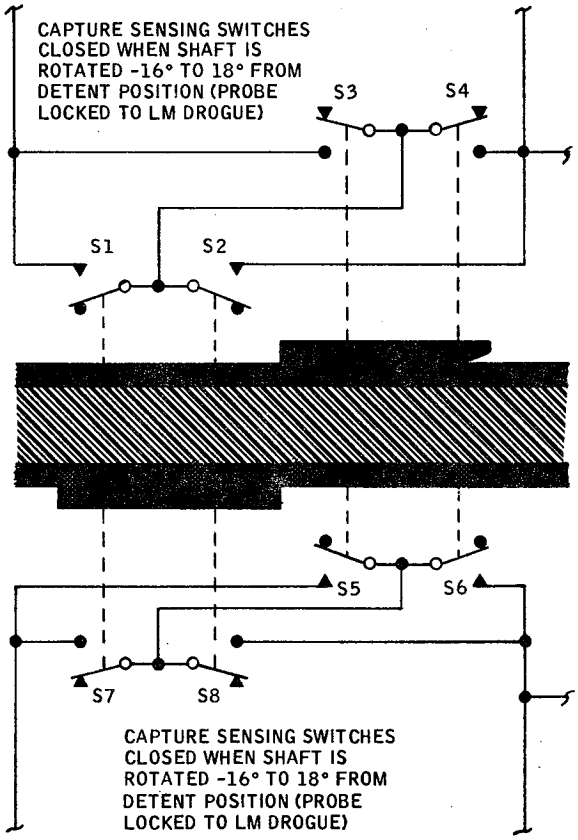
2. DWG 2.7 J,I Z 7,6

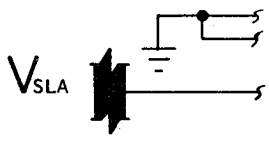


3. DWG 2.7 P Z 7



WAS

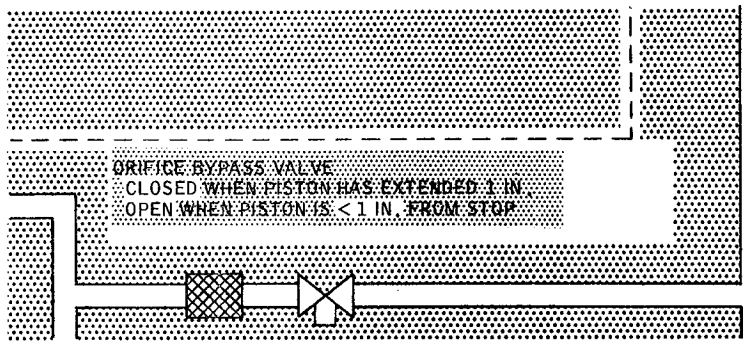




SECTION 2

IS

4. DWG 2.7 L,K $\angle$ 7



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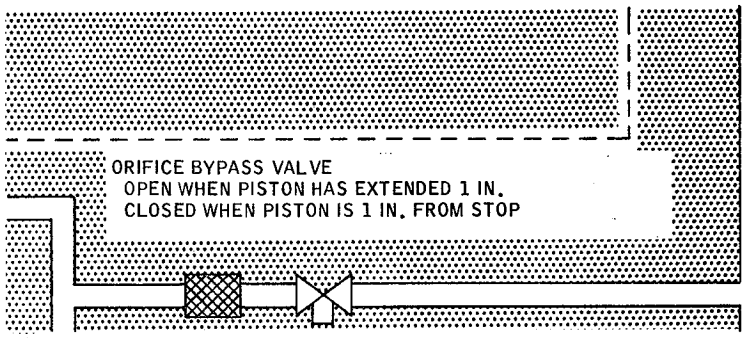
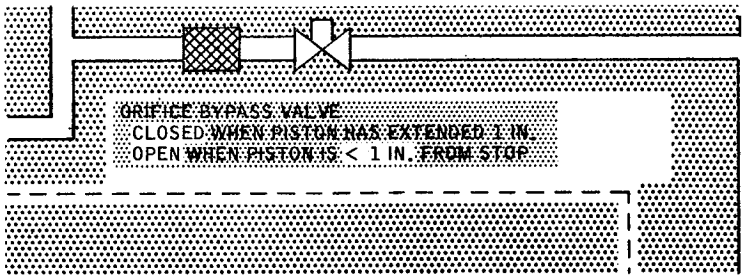
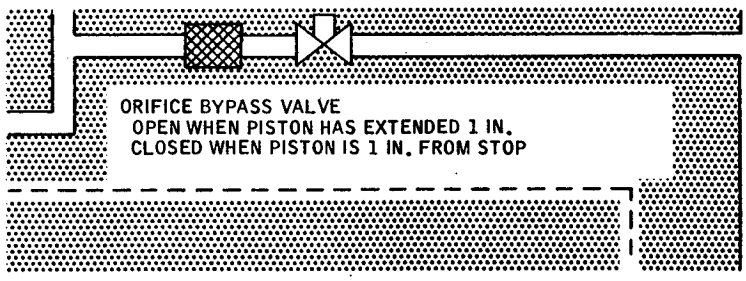


5. DWG 2.7 L,K $\angle$ 6

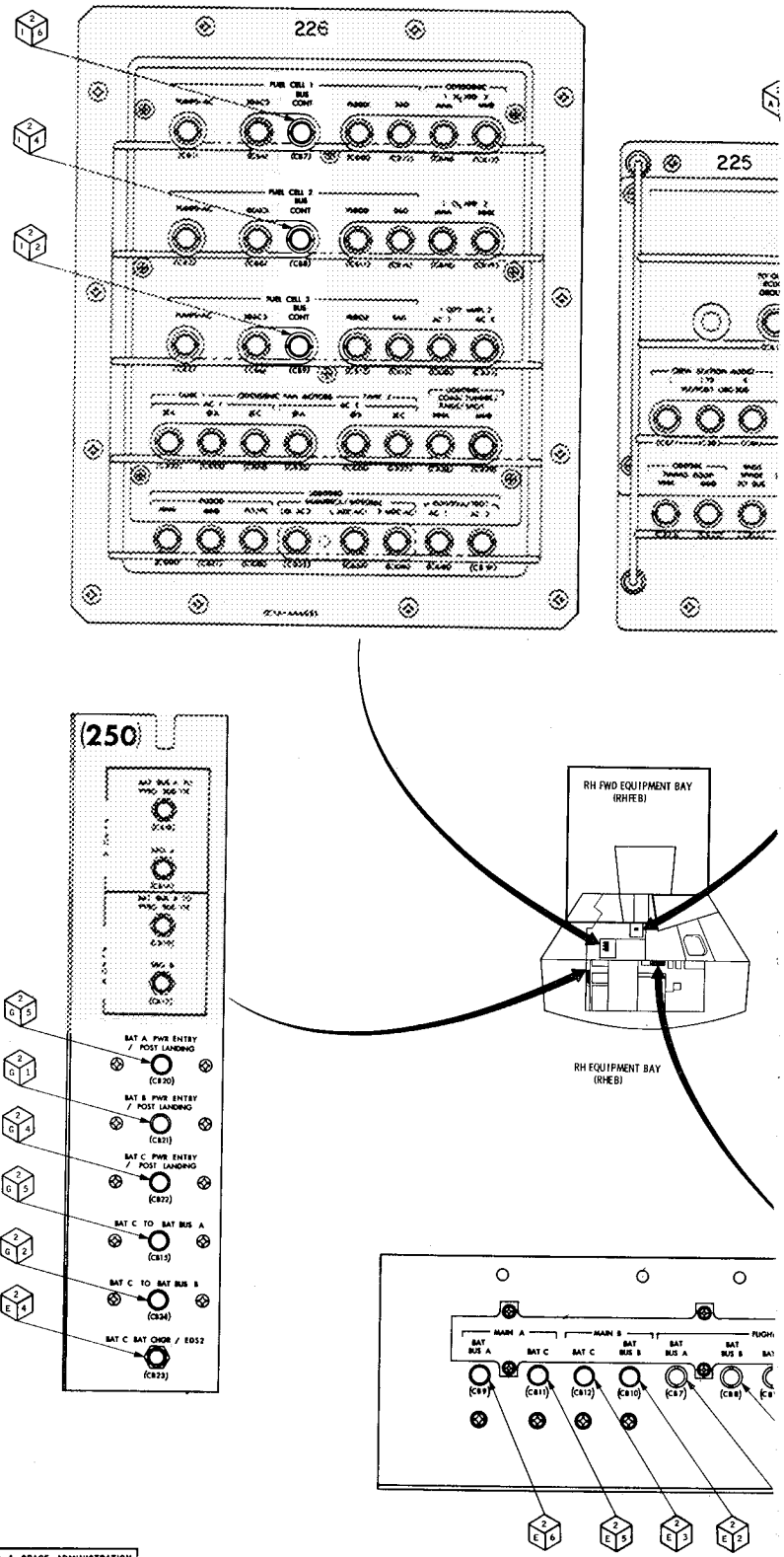
IS



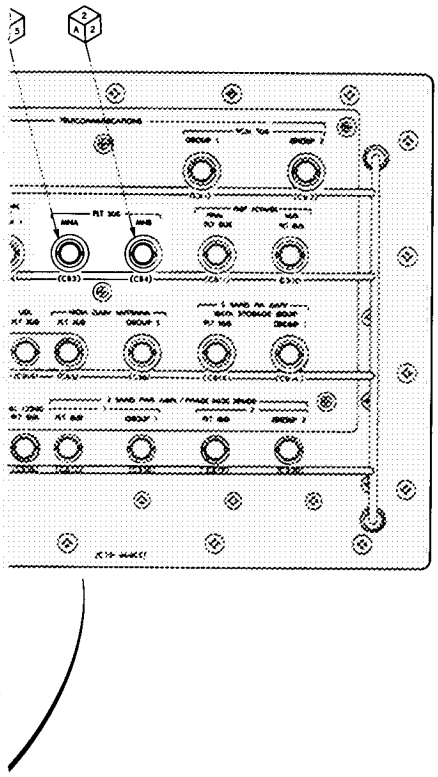
WAS

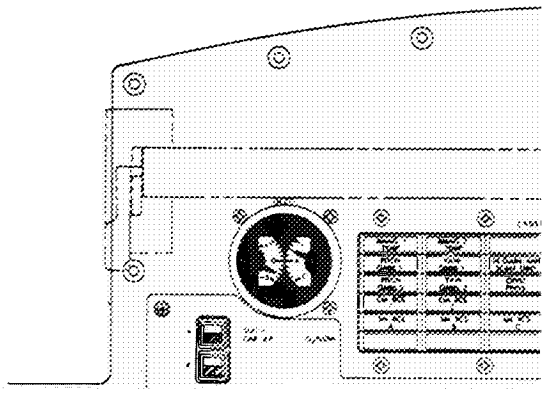


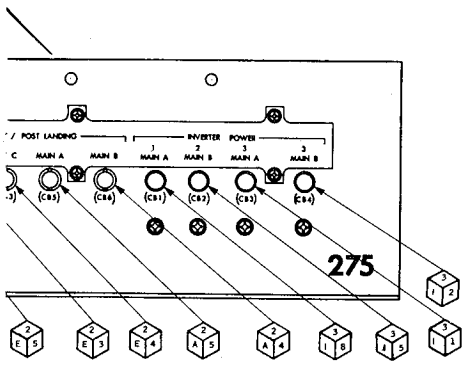
3 ELECTRICAL SYSTEM

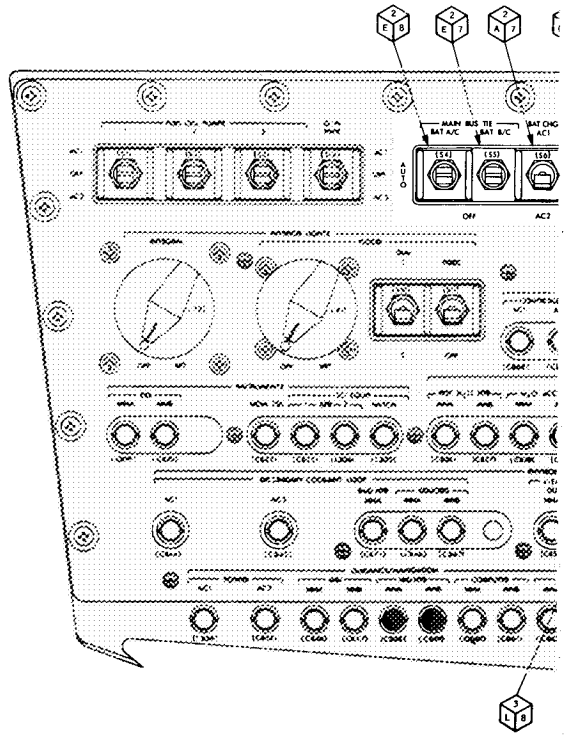


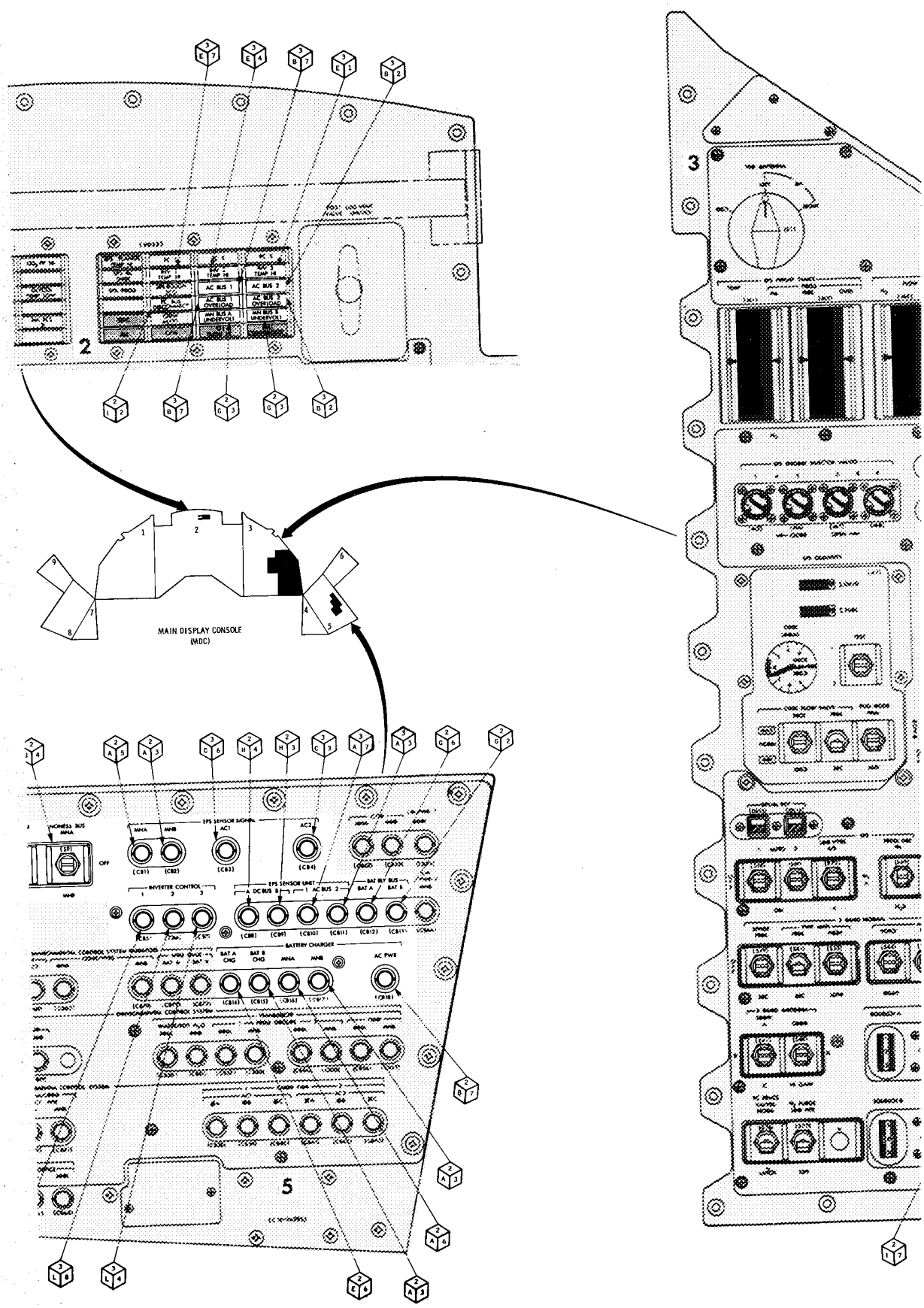
NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER · HOUSTON, TEXAS		
ELECTRICAL POWER SYSTEM CONTROL-DISPLAY FIGURE		
DWG NO. **FIGURE 3.1**	SIZE J	CSM 104
SHEET OF PAGE		35.75 X 84

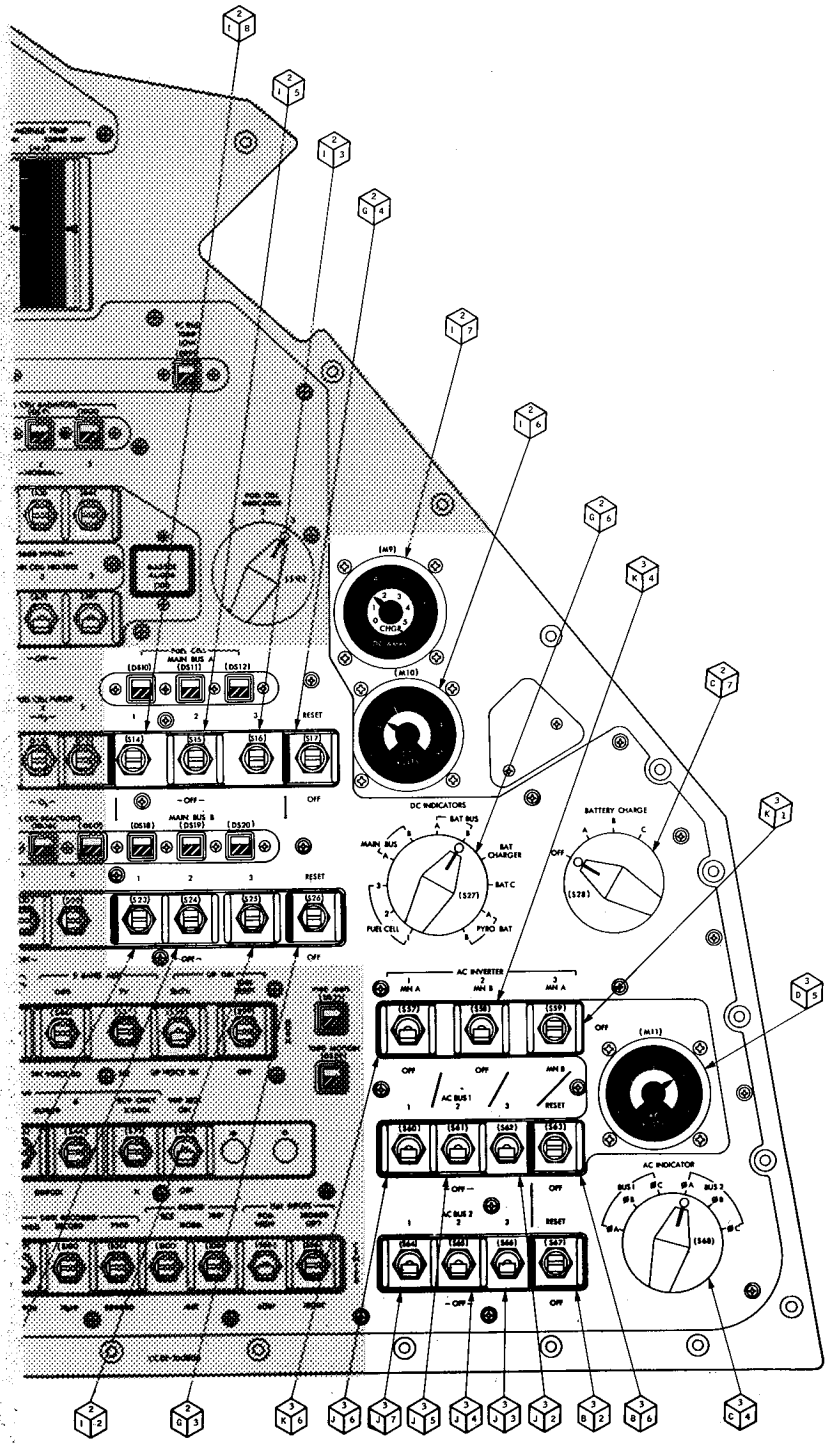


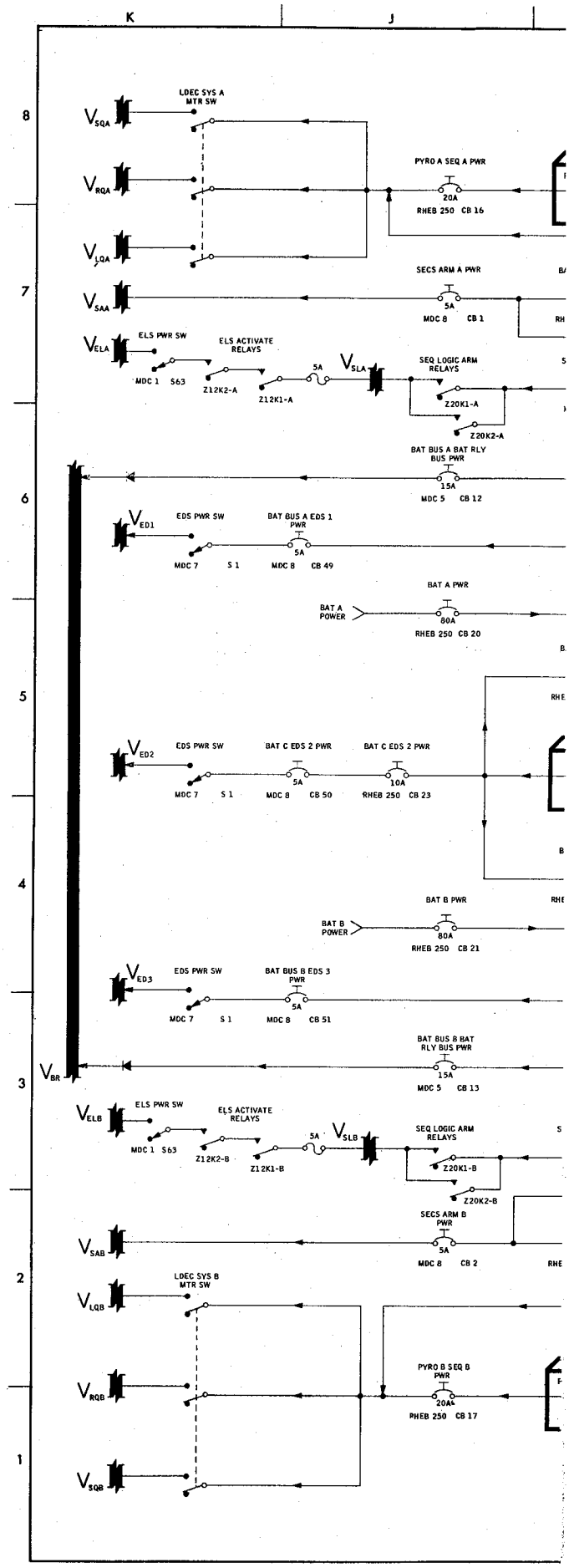



POST LANDING
INVERTER POWER
MAIN A
MAIN B
MAIN A
MAIN B
MAIN A
MAIN B
275


MAIN BUS TIE
BAT A/C
BAT B/C
BAT CHG
AC1
OFF
AC2

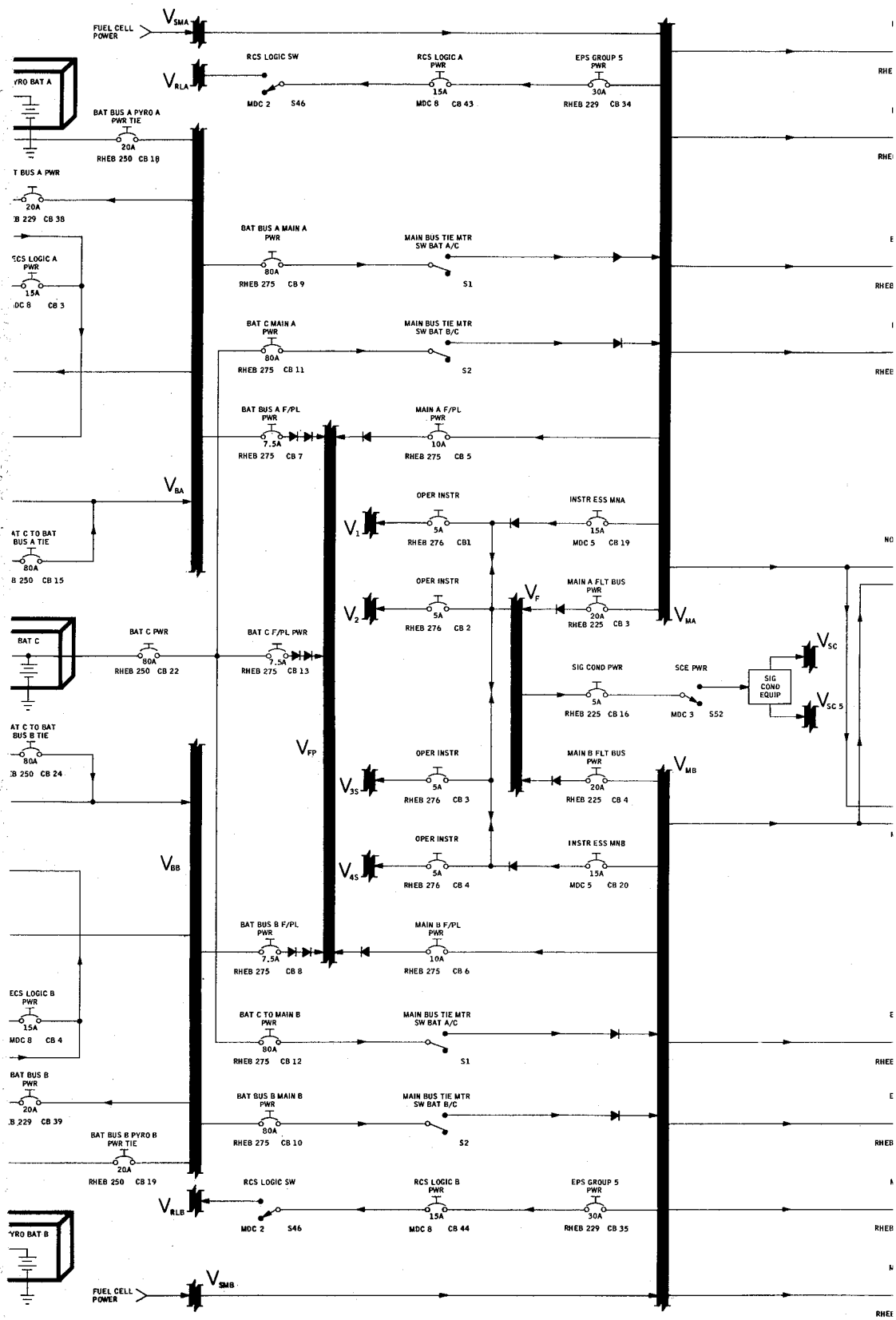

2
3
MAIN DISPLAY CONSOLE
(MDC)
5

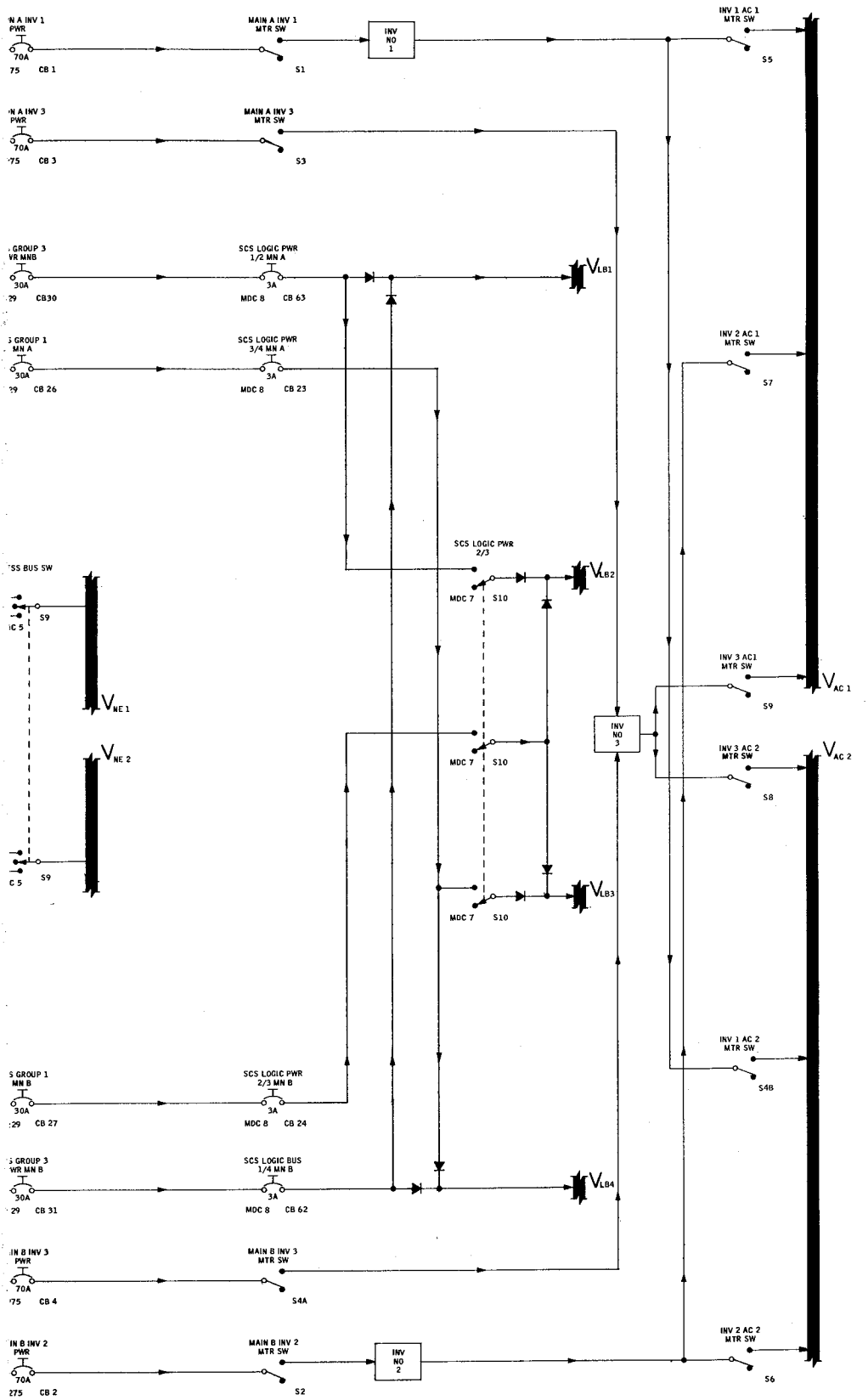

CMG
DC INDICATORS
BAT BUS
MAIN BUS
BAT CHARGER
BAT C
FUEL CELL
PYRO BAT
BATTERY CHARGE
AC INVERTER
AC BUS 1
AC BUS 2
AC INDICATOR
RESET
OFF


K
J
8
7
6
5
4
3
2
1
V_{SQA}
V_{RQA}
V_{LQA}
LDEC SYS A MTR SW
PYRO A SEQ A PWR
20A
RHEB 250 CB 16
V_{SAA}
SECS ARM A PWR
5A
MDC 8 CB 1
V_{ELA}
ELS PWR SW
MDC 1 S63
ELS ACTIVATE RELAYS
Z12K2-A
Z12K1-A
5A
V_{SLA}
SEQ LOGIC ARM RELAYS
Z20K1-A
Z20K2-A
BAT BUS A BAT RLY BUS PWR
15A
MDC 5 CB 12
V_{ED1}
EDS PWR SW
MDC 7 S 1
BAT BUS A EDS 1 PWR
5A
MDC 8 CB 49
BAT A POWER
BAT A PWR
80A
RHEB 250 CB 20
V_{ED2}
EDS PWR SW
MDC 7 S 1
BAT C EDS 2 PWR
5A
MDC 8 CB 50
BAT C EDS 2 PWR
10A
RHEB 250 CB 23
BAT B POWER
BAT B PWR
80A
RHEB 250 CB 21
V_{ED3}
EDS PWR SW
MDC 7 S 1
BAT BUS B EDS 3 PWR
5A
MDC 8 CB 51
V_{BR}
BAT BUS B BAT RLY BUS PWR
15A
MDC 5 CB 13
V_{ELB}
ELS PWR SW
MDC 1 S63
ELS ACTIVATE RELAYS
Z12K2-B
Z12K1-B
5A
V_{SLB}
SEQ LOGIC ARM RELAYS
Z20K1-B
Z20K2-B
V_{SAB}
SECS ARM B PWR
5A
MDC 8 CB 2
V_{LQB}
LDEC SYS B MTR SW
V_{RQB}
PYRO B SEQ B PWR
20A
RHEB 250 CB 17
V_{SQB}

CSM ELECTRICAL BUS DISTRIBUTION

NOTE: SEE SYSTEM DRAWINGS FOR FURTHER DETAILS





1 EPS

SIGNATURES	DATE
DR	
DSGN	
QC	
EMGR C.M. Jones	12/13/63
NR	12/13/63
APP	12/13/63
FEC	
AUTH	

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS

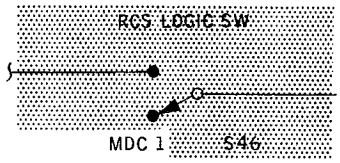
ELECTRICAL POWER SYSTEM OVERVIEW

CSM 104 | DWG NO 3.1 | 35.5 X 62 | PAGE | SHEET OF

SECTION 3

IS

1. DWG 3.1 H Z 8



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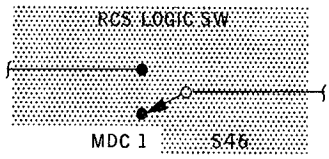

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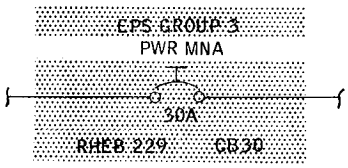
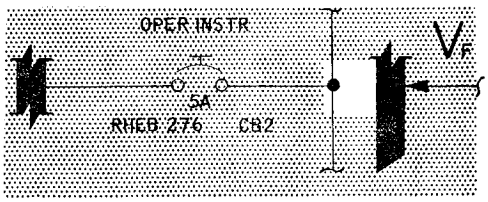
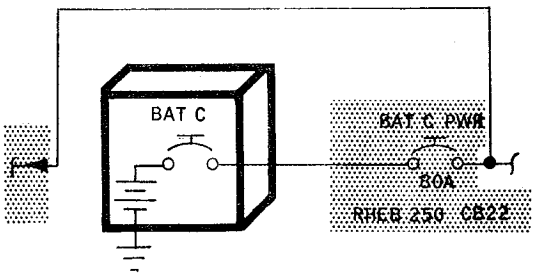


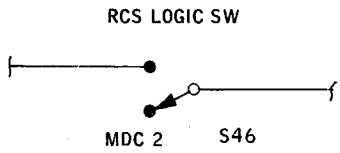
4. DWG 3.1 G Z 5

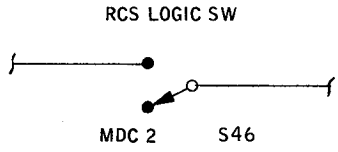


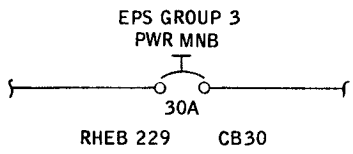
5. DWG 3.1 I Z 5

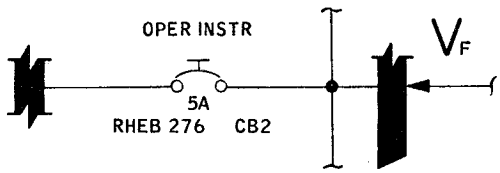


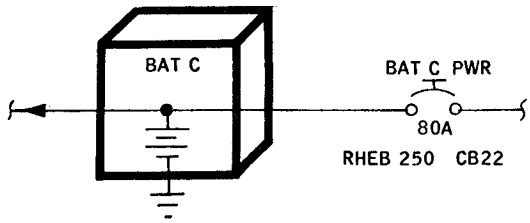
WAS





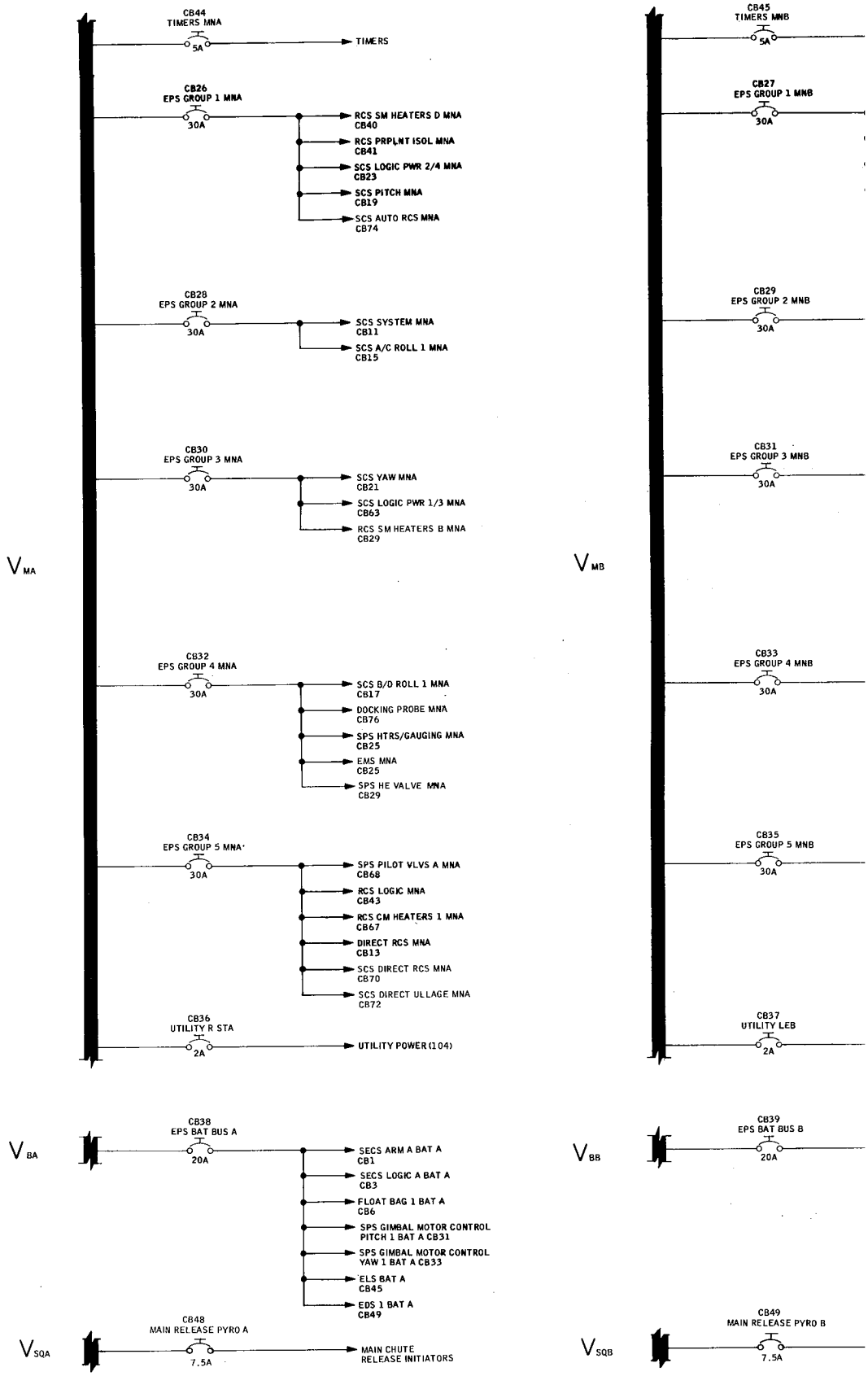


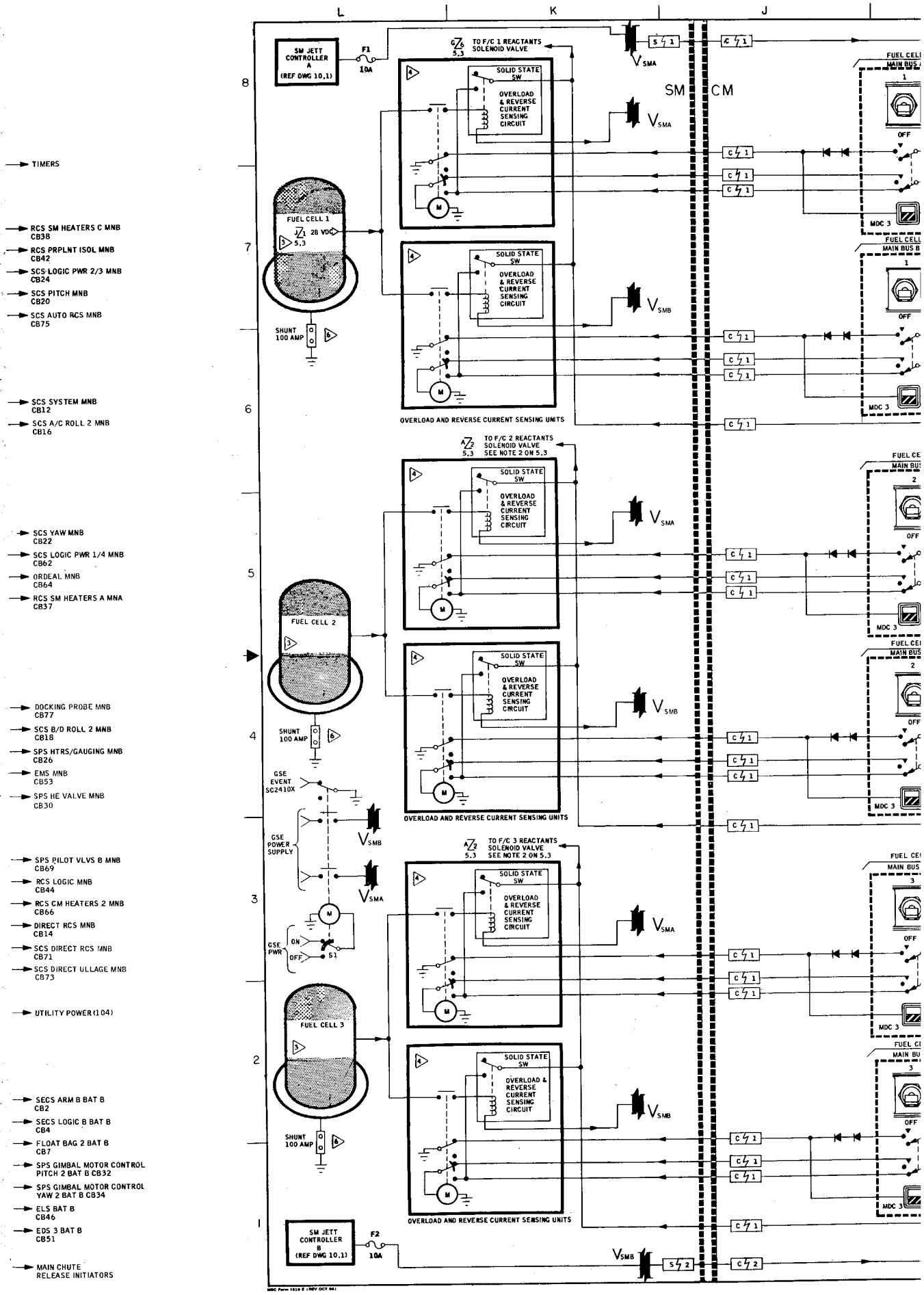


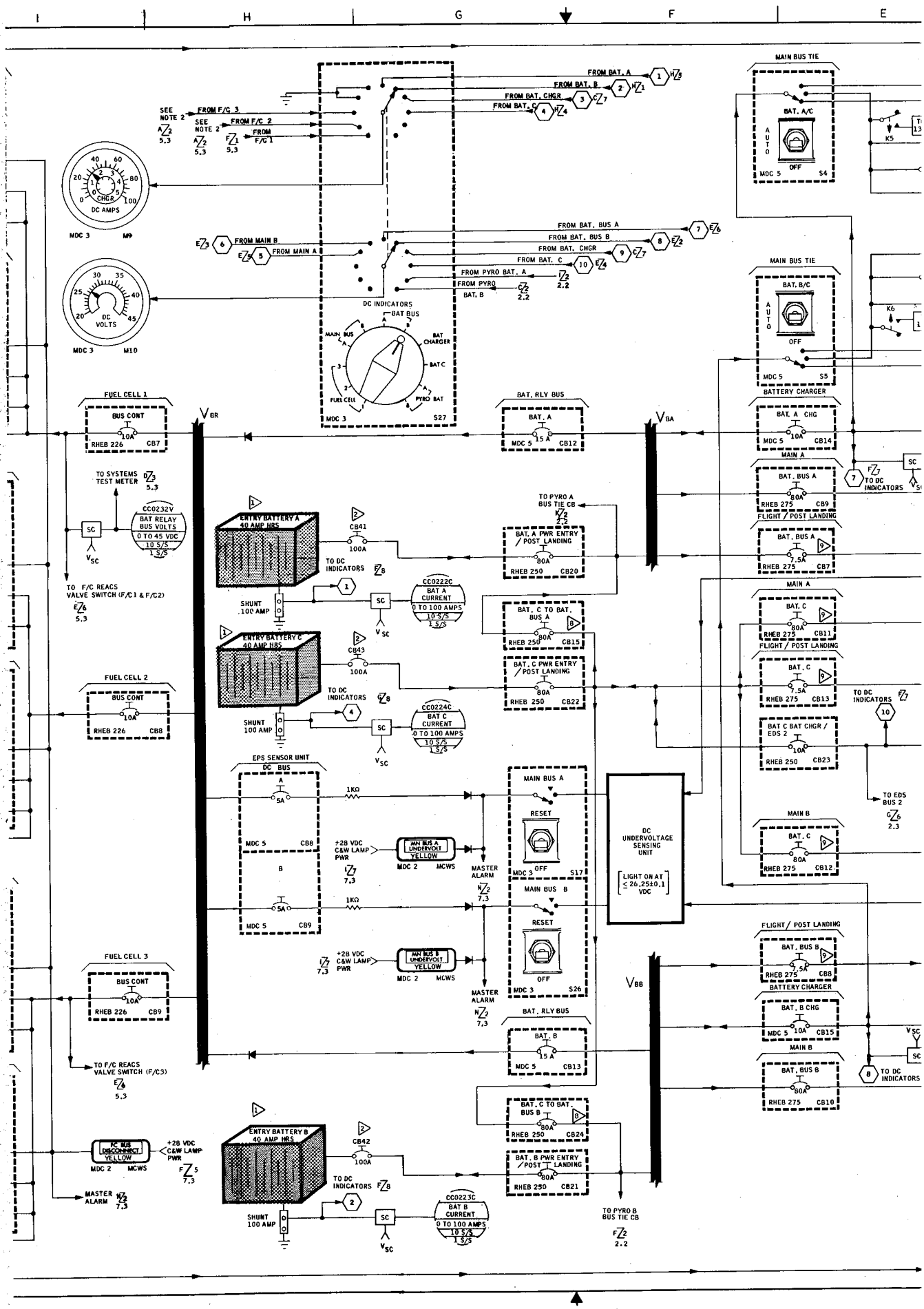


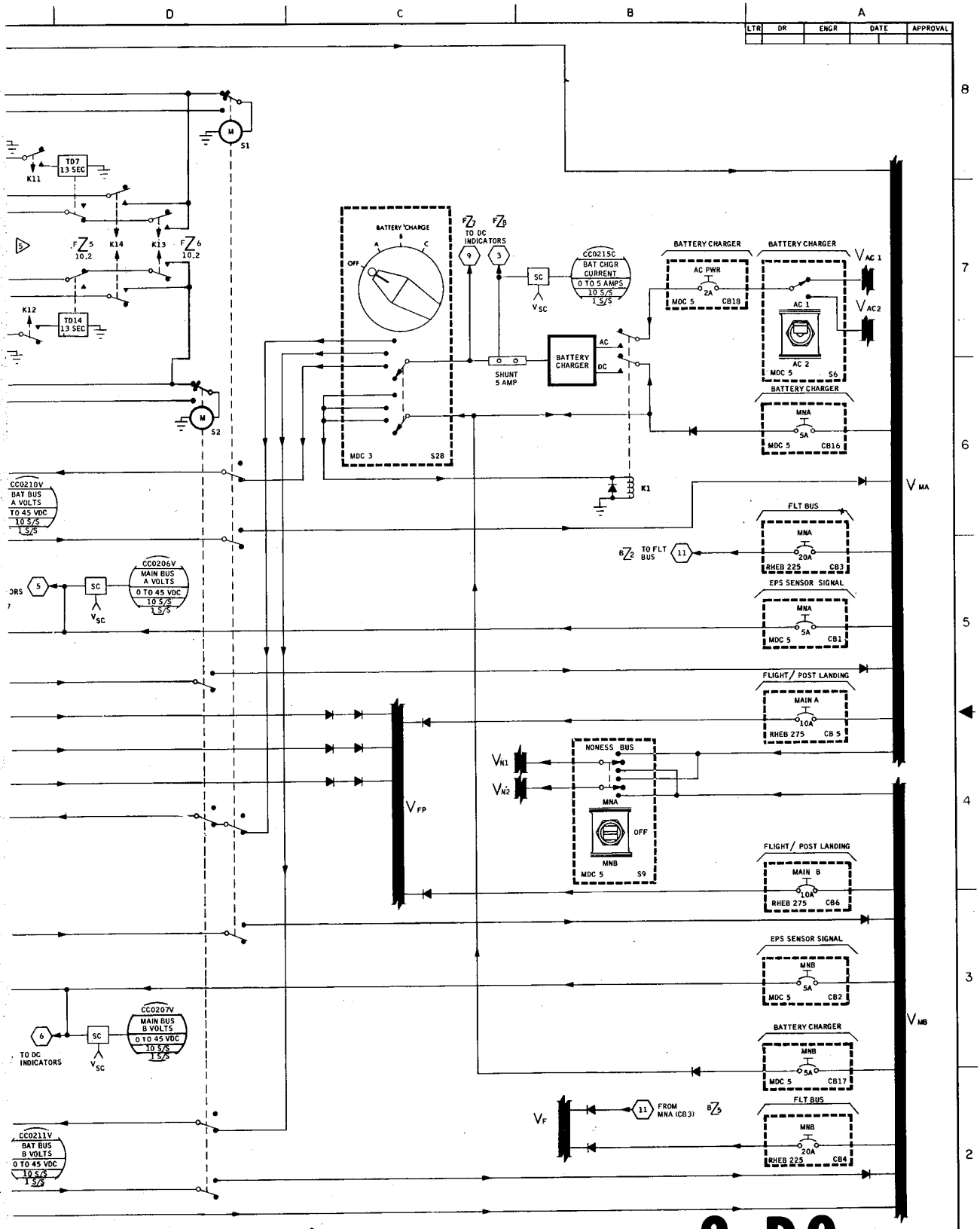
RHEB-229 POWER DISTRIBUTION

NOTE: THESE CIRCUIT BREAKERS WERE INSTALLED TO PROTECT LONG WIRE LEADS




L
K
J
SM JETT CONTROLLER A (REF DWG 10,1)
F1 10A
TO F/C 1 REACTANTS SOLENOID VALVE
SOLID STATE SW
OVERLOAD & REVERSE CURRENT SENSING CIRCUIT
SM
CM
FUEL CELL 1
28 VDC
SHUNT 100 AMP
OVERLOAD AND REVERSE CURRENT SENSING UNITS
TO F/C 2 REACTANTS SOLENOID VALVE SEE NOTE 2 ON 5,3
FUEL CELL 2
GSE EVENT SC2410X
GSE POWER SUPPLY
GSE PWR
ON
OFF
S1
TO F/C 3 REACTANTS SOLENOID VALVE SEE NOTE 2 ON 5,3
FUEL CELL 3
OVERLOAD & REVERSE CURRENT SENSING CIRCUIT
SM JETT CONTROLLER B (REF DWG 10,1)
F2 10A
MDC 3
OFF
TIMERS
RCS SM HEATERS C MNB CB38
RCS PRPLNT ISOL MNB CB42
SCS LOGIC PWR 2/3 MNB CB24
SCS PITCH MNB CB20
SCS AUTO RCS MNB CB75
SCS SYSTEM MNB CB12
SCS A/C ROLL 2 MNB CB16
SCS YAW MNB CB22
SCS LOGIC PWR 1/4 MNB CB62
ORDEAL MNB CB64
RCS SM HEATERS A MNA CB37
DOCKING PROBE MNB CB77
SCS B/D ROLL 2 MNB CB18
SPS HTRS/GAUGING MNB CB26
EMS MNB CB53
SPS HE VALVE MNB CB30
SPS PILOT VLVS B MNB CB69
RCS LOGIC MNB CB44
RCS CM HEATERS 2 MNB CB66
DIRECT RCS MNB CB14
SCS DIRECT RCS MNB CB71
SCS DIRECT ULLAGE MNB CB73
UTILITY POWER(104)
SECS ARM B BAT B CB2
SECS LOGIC B BAT B CB4
FLOAT BAG 2 BAT B CB7
SPS GIMBAL MOTOR CONTROL PITCH 2 BAT B CB32
SPS GIMBAL MOTOR CONTROL YAW 2 BAT B CB34
ELS BAT B CB46
EDS 3 BAT B CB51
MAIN CHUTE RELEASE INITIATORS


I
H
G
F
E
SEE NOTE 2
FROM F/C 3
FROM F/C 2
FROM F/C 1
FROM BAT. A
FROM BAT. B
FROM BAT. CHGR
FROM BAT. C
FROM MAIN B
FROM MAIN A
FROM BAT. BUS A
FROM BAT. BUS B
FROM PYRO BAT. A
FROM PYRO BAT. B
DC AMPS
CHGR
MDC 3 M9
DC VOLTS
MDC 3 M10
DC INDICATORS
BAT BUS
MAIN BUS A
MAIN BUS B
BAT CHARGER
BAT C
FUEL CELL
PYRO BAT
MDC 3 S27
MAIN BUS TIE
BAT. A/C
BAT. B/C
AUTO
OFF
MDC 5 S4
MDC 5 S5
FUEL CELL 1
FUEL CELL 2
FUEL CELL 3
BUS CONT
10A
RHEB 226 CB7
RHEB 226 CB8
RHEB 226 CB9
V_{BR}
V_{BA}
V_{BB}
BAT. RLY BUS
BAT. A
BAT. B
15 A
MDC 5 CB12
MDC 5 CB13
BATTERY CHARGER
BAT. A CHG
BAT. B CHG
MDC 5 CB14
MDC 5 CB15
MAIN A
BAT. BUS A
80A
RHEB 275 CB9
FLIGHT / POST LANDING
7.5A
RHEB 275 CB7
MAIN B
BAT. BUS B
RHEB 275 CB10
RHEB 275 CB8
TO PYRO A BUS TIE CB
TO PYRO B BUS TIE CB
TO SYSTEMS TEST METER
TO F/C REACS VALVE SWITCH (F/C1 & F/C2)
TO F/C REACS VALVE SWITCH (F/C3)
CC0232V
BAT RELAY BUS VOLTS
0 TO 45 VDC
10 S/S
1 S/S
ENTRY BATTERY A 40 AMP HRS
ENTRY BATTERY B 40 AMP HRS
ENTRY BATTERY C 40 AMP HRS
CB41
CB42
CB43
100A
SHUNT 100 AMP
TO DC INDICATORS
CC0222C
BAT A CURRENT
CC0223C
BAT B CURRENT
CC0224C
BAT C CURRENT
0 TO 100 AMPS
BAT. A PWR ENTRY / POST LANDING
BAT. B PWR ENTRY / POST LANDING
BAT. C PWR ENTRY / POST LANDING
BAT. C TO BAT. BUS A
BAT. C TO BAT. BUS B
RHEB 250 CB20
RHEB 250 CB21
RHEB 250 CB22
RHEB 250 CB15
RHEB 250 CB24
BAT C BAT CHGR / EDS 2
RHEB 250 CB23
EPS SENSOR UNIT
DC BUS
5A
1KΩ
MDC 5 CB8
MDC 5 CB9
+28 VDC C&W LAMP PWR
MN BUS A UNDERVOLT YELLOW
MN BUS B UNDERVOLT YELLOW
MDC 2 MCWS
MASTER ALARM
MAIN BUS A
MAIN BUS B
RESET
OFF
MDC 3 S17
MDC 3 S26
DC UNDERVOLTAGE SENSING UNIT
LIGHT ON AT ≤ 26.25±0.1 VDC
DC BUS DISCONNECT YELLOW
TO EDS BUS 2
TO DC INDICATORS


D
C
B
A
LTR
DR
ENGR
DATE
APPROVAL
8
7
6
5
4
3
2
1
S1
S2
K11
K12
K13
K14
TD7
13 SEC
TD14
13 SEC
F Z 5
10.2
F Z 6
10.2
BATTERY CHARGE
A
C
OFF
MDC 3
S28
F Z 7
F Z 8
TO DC
INDICATORS
9
3
SC
V SC
CC0215C
BAT CHGR
CURRENT
0 TO 5 AMPS
10 S/S
1 S/S
SHUNT
5 AMP
BATTERY
CHARGER
AC
DC
K1
BATTERY CHARGER
AC PWR
2A
MDC 5
CB18
BATTERY CHARGER
V AC 1
V AC2
AC 1
AC 2
MDC 5
S6
BATTERY CHARGER
MNA
5A
MDC 5
CB16
V MA
CC0210V
BAT BUS
A VOLTS
TO 45 VDC
10 S/S
1 S/S
B Z 2
TO FLT
BUS
11
FLT BUS
MNA
20A
RHEB 225
CB3
EPS SENSOR SIGNAL
MNA
5A
MDC 5
CB1
CC0206V
MAIN BUS
A VOLTS
0 TO 45 VDC
10 S/S
1 S/S
5
FLIGHT/ POST LANDING
MAIN A
10A
RHEB 275
CB 5
V FP
V N1
V N2
NONESS BUS
MNA
OFF
MNB
MDC 5
S9
FLIGHT/ POST LANDING
MAIN B
10A
RHEB 275
CB6
EPS SENSOR SIGNAL
MNB
5A
MDC 5
CB2
V MB
CC0207V
MAIN BUS
B VOLTS
0 TO 45 VDC
10 S/S
1 S/S
6
TO DC
INDICATORS
BATTERY CHARGER
MNB
5A
MDC 5
CB17
V F
11
FROM
MNA (CB3)
B Z 5
FLT BUS
MNB
20A
RHEB 225
CB4
CC0211V
BAT BUS
B VOLTS
0 TO 45 VDC
10 S/S
1 S/S
NORMALLY OPEN UNLESS BATTERY MALFUNCTION
NORMALLY OPEN UNTIL ENTRY
NOTES:
1. BATTERY VENT PRESS ONBOARD READOUT SHOWN ON 4.5
2. CB41,CB42 AND CB43 ARE INACCESSIBLE
3. FOR DETAILS OF FUEL CELL SEE DWG 5.3
4. FUEL CELL DISCONNECT FOR:
A. OVERLOAD ≥ 75 AMPS
B. REVERSE CURRENT > 4 AMPS
5. RELAYS K5,K6,K11 AND K12 CLOSE:
A. 1B SEC AFTER PAD ABORT
B. AFTER CSM PROP JETT PURGE
C. AFTER He DUMP
SEE H Z 4 10.2
6. FUEL CELL CURRENT (TM & ONBOARD) SHOWN ON 5.3
7. STRIPED INDICATES FUEL CELL OFF BUS
WHITE (GRAY) INDICATES FUEL CELL ON BUS
2 DC
SIGNATURES
DATE
DR
DSGN
QC
ENGR C.M.
NR
AFP
FEC
AUTH
7-30-68
12/3/68
12-9-68
NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER • HOUSTON, TEXAS
ELECTRICAL
DIRECT CURRENT
DISTRIBUTION & CONTROL SYS
CSM
104
SIZE
J
DWG NO.
3.2
66 x 34
PAGE
SHEET 1 OF 1

CORRECTIONS TO FIGURE 3.2, POWER DISTRIBUTION MATRIX, MAIN BUSES

V_{MA} (MAIN BUS A OR B)	RHEB	MDC		CHANGE
		MDC-5		
		CB32		SECOND ITEM SHOULD READ: SUIT COMP DIFF-PRESS SENSOR DIODE SHARED
		CB34		FOURTH ITEM - DELETE THE MNB, CB35 INPUT AND SHOULD READ: CO_2 PARTIAL PRESSURE SENSOR
		CB36		FIRST ITEM ADD: SUIT HEAT EXCHANGER OUT TEMP
		CB46		THIRD ITEM SHOULD READ: SEC EVAP OUT STEAM PRESSURE SENSOR DIODE SHARED
		CB50	(0.14A)	ADD AS A THIRD ITEM: WASTE H_2O LINE STRIP HTR 1 URINE LINE STRIP HTR 1 LOSS OF BOTH HTRS
	RHEB 229	MDC-8		
	CB26	CB23		FIRST ITEM SHOULD READ: LOGIC POWER 2/3 SW (S10-MDC 7) LOGIC BUS 3 DIODE SHARED MNB PWR CB24
	CB26	CB41		SECOND ITEM SHOULD READ: SM RCS SYS B & D PRPLNT ISOL SWITCHES S48, S50, S117, S119 MDC 2 (PRIM AND SEC) LOSS OF SM BANK B AND D RCS PROP ISOL VALVES
	CB28	CB11		THIRD ITEM: S8 NOT S9
	CB28	CB15		CB15 TITLE: A/C NOT AC
	CB30	CB63		FIRST ITEM SHOULD READ: LOGIC POWER 2/3 SW (S10-MDC 7) LOGIC BUS 2 DIODE SHARED MNB PWR CB24

CORRECTIONS TO FIGURE 3.2, POWER DISTRIBUTION MATRIX, MAIN BUSES – Continued

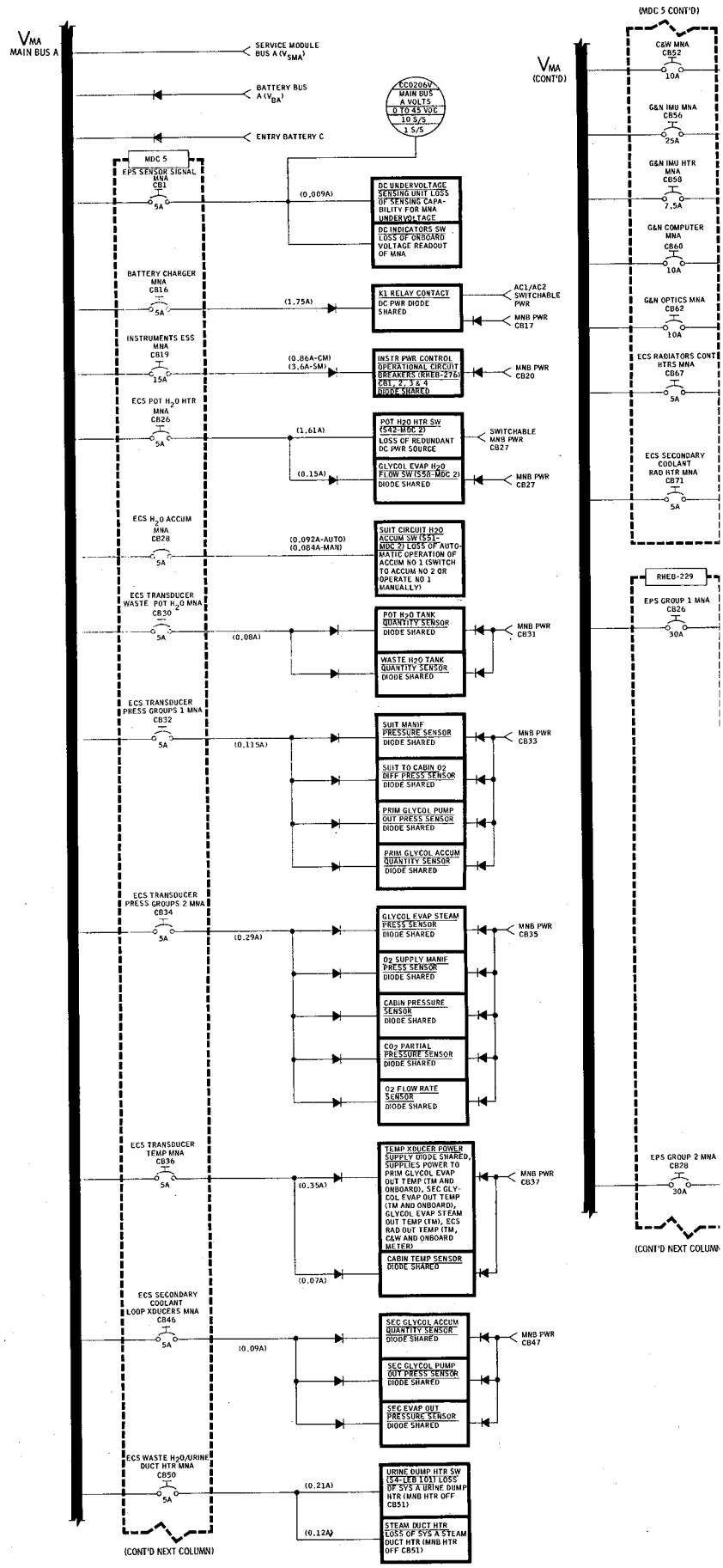
$V_{(MAIN\ BUS\ A\ OR\ B)}$ / V_{MB}	RHEB	MDC		CHANGE
		MDC-5		
		CB35		DELETE THE FOURTH ITEM
		CB37		FIRST ITEM ADD: SUIT HEAT EXCHANGER OUT TEMP
		CB47		THIRD ITEM SHOULD READ: SEC EVAP OUT STEAM PRESSOR SENSOR DIODE SHARED
		CB51		FIRST ITEM SHOULD READ: URINE DUMP HTR SW (S4 LEB 101) LOSS OF SYS B URINE DUMP HTR AND SYS B WASTE H_2O DUMP HTR.
		CB51	(0.14A)	ADD FOLLOWING AS THIRD ITEM: WASTE H_2O LINE STRIP HTR 2 URINE LINE STRIP HTR 2 LOSS OF BOTH STRIP HTRS
	RHEB 229	MDC-8		
	CB27	CB24		SECOND ITEM SHOULD READ: LOGIC PWR 2/3 SW (S10-MDC 7) LOGIC BUSES 2 AND 3 DIODE SHARED MNA PWR CB23
	CB27	CB42		SECOND ITEM SHOULD READ: SM RCS SYS A & C PRPLNT ISOL SWITCHES (S47, S49, S116, S118 - MDC 2) LOSS OF SM BANK A AND C RCS PRPLNT CONTROL VALVES
	CB31		(0.143A)	ADD ORDEAL MNB CB64, 5 AMP (AS A NEW CB) TO READ: ORDEAL LOSS OF ORDEAL USE BACKUP PROCEDURES
	CB33	CB18		CB18 TITLE: B/D NOT BD

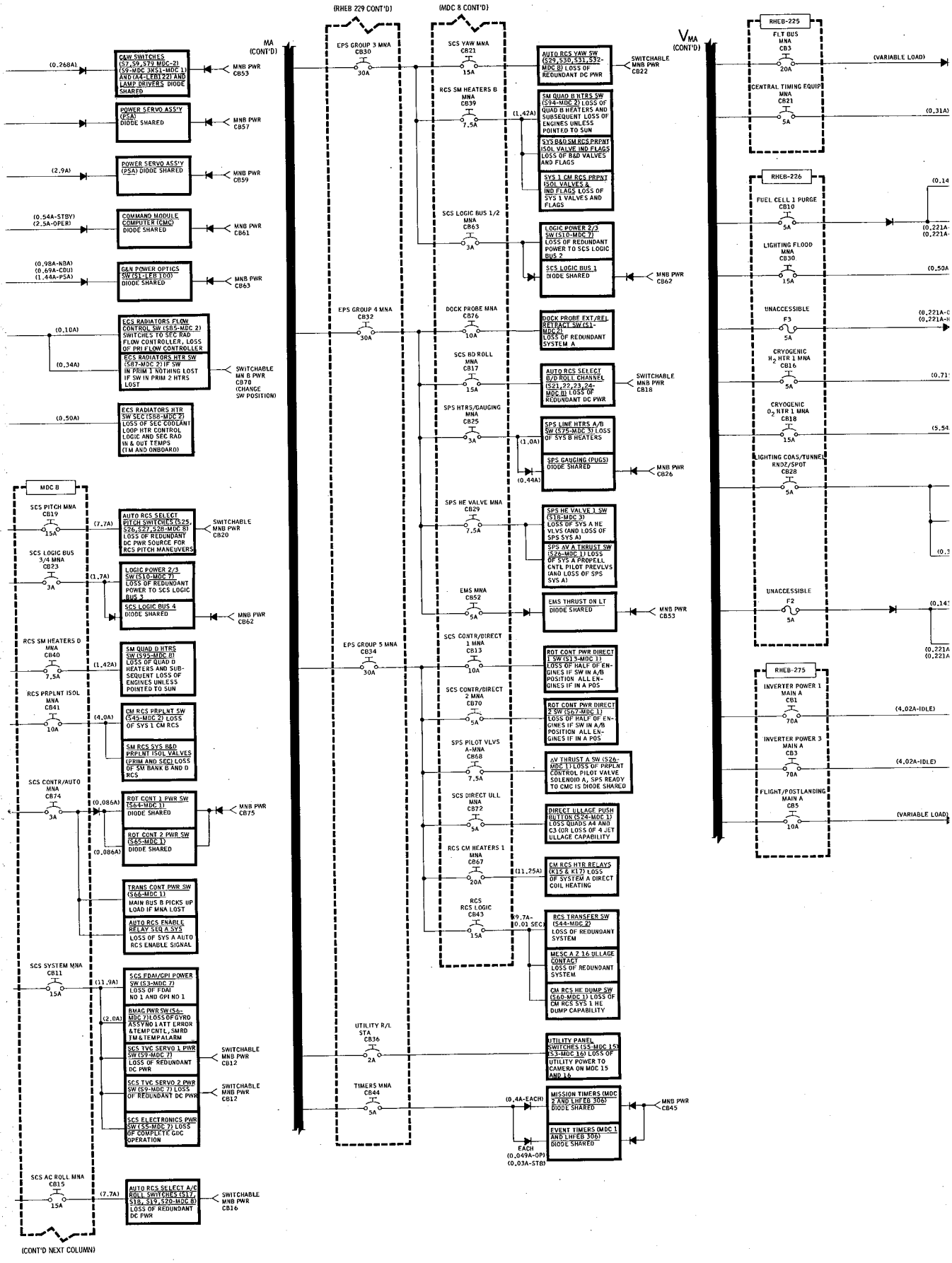
CORRECTIONS TO FIGURE 3.2, POWER DISTRIBUTION MATRIX, MAIN BUSES - Continued

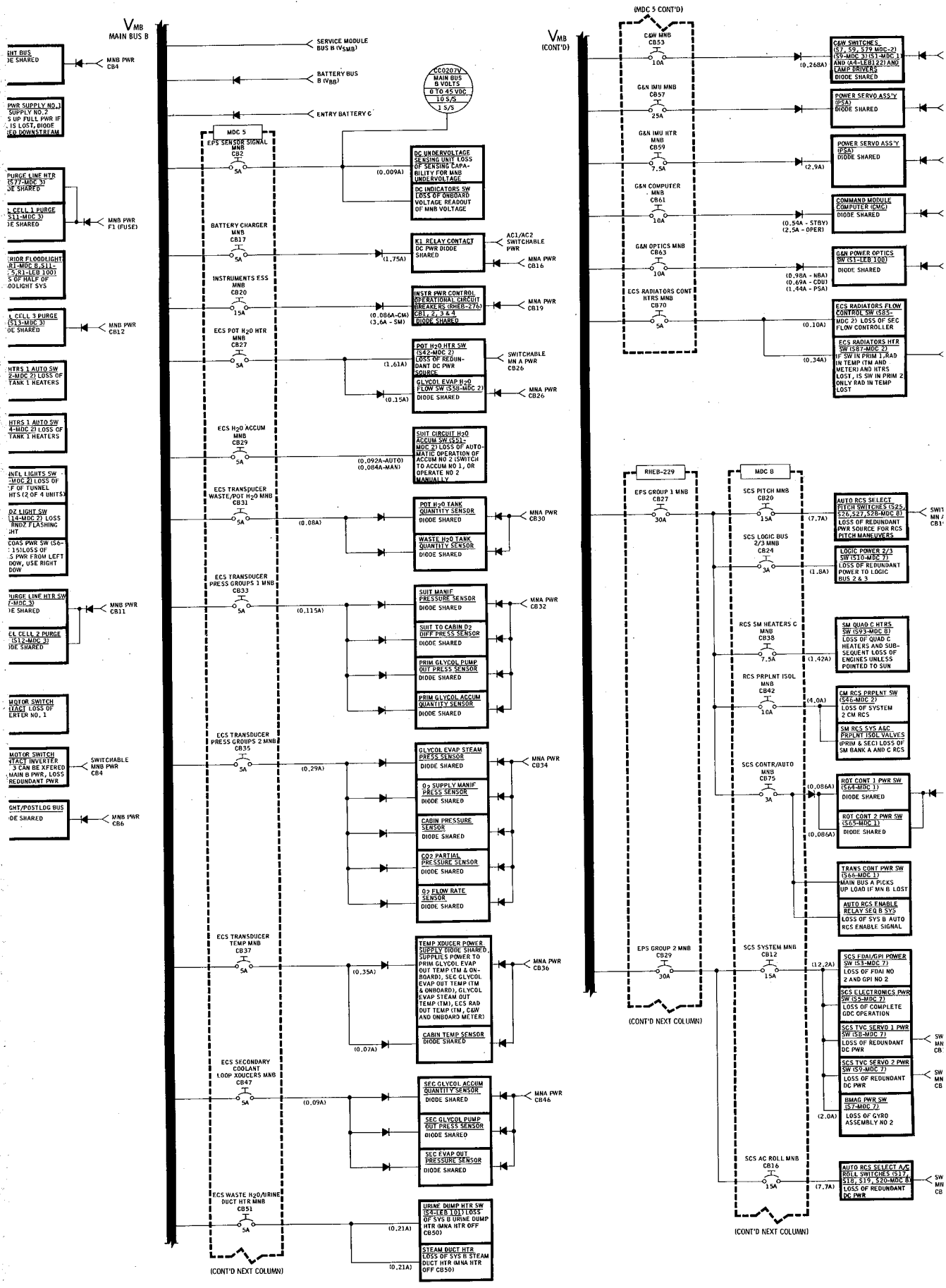
$V_{(MAIN\ BUS\ A\ OR\ B)}$ / V_{MA}	RHEB	MDC	CHANGE
	RHEB 229	MDC-8	
	CB32	CB17	CB17 TITLE: B/D NOT BD
	CB32	CB25	FIRST ITEM SHOULD READ: SPS LINE HTRS A/B SW (S75-MDC 3) LOSS OF SYS A HEATERS
	CB34	CB13	SHOULD READ: ROT CONT PWR DIRECT 1 SW (S13-MDC 1). LOSS OF HALF OF DIRECT CONTROL IF SW IN A/B POSITION; ALL, IF IN A POS
	CB34	CB70	SHOULD READ: ROT CONT PWR DIRECT 2 SW (S67-MDC 1) LOSS OF HALF OF DIRECT CONTROL IF SW IN A/B OR B POS
	CB34	CB68	SHOULD READ: ΔV THRUST A SW (S26-MDC 1) LOSS OF PRPLNT CONTROL PILOT VALVE SOLENOID A
	CB34	CB72	SHOULD READ: DIRECT ULLAGE PUSH BUTTON (S24-MDC 1) LOSS OF QUADS B4 AND D3 (OR LOSS OF A JET ULLAGE CAPABILITY).
	CB34	CB43	DELETE THIRD ITEM AND ADD FOLLOWING AS NEW THIRD ITEM: CSM RCS LOGIC SW (S46-MDC 1) LOSS OF RCS LOGIC BUS
	CB44		FIRST ITEM - DELETE DIODES AND MNB PWR CB45, THEN CORRECT TO READ: MISSION TIMERS (MDC 2) LOSS OF TIMER
V_{MB}		MDC-5	SECOND ITEM SHOULD READ:
		CB33	SUIT COMP DIFF-PRESS SENSOR DIODE SHARED

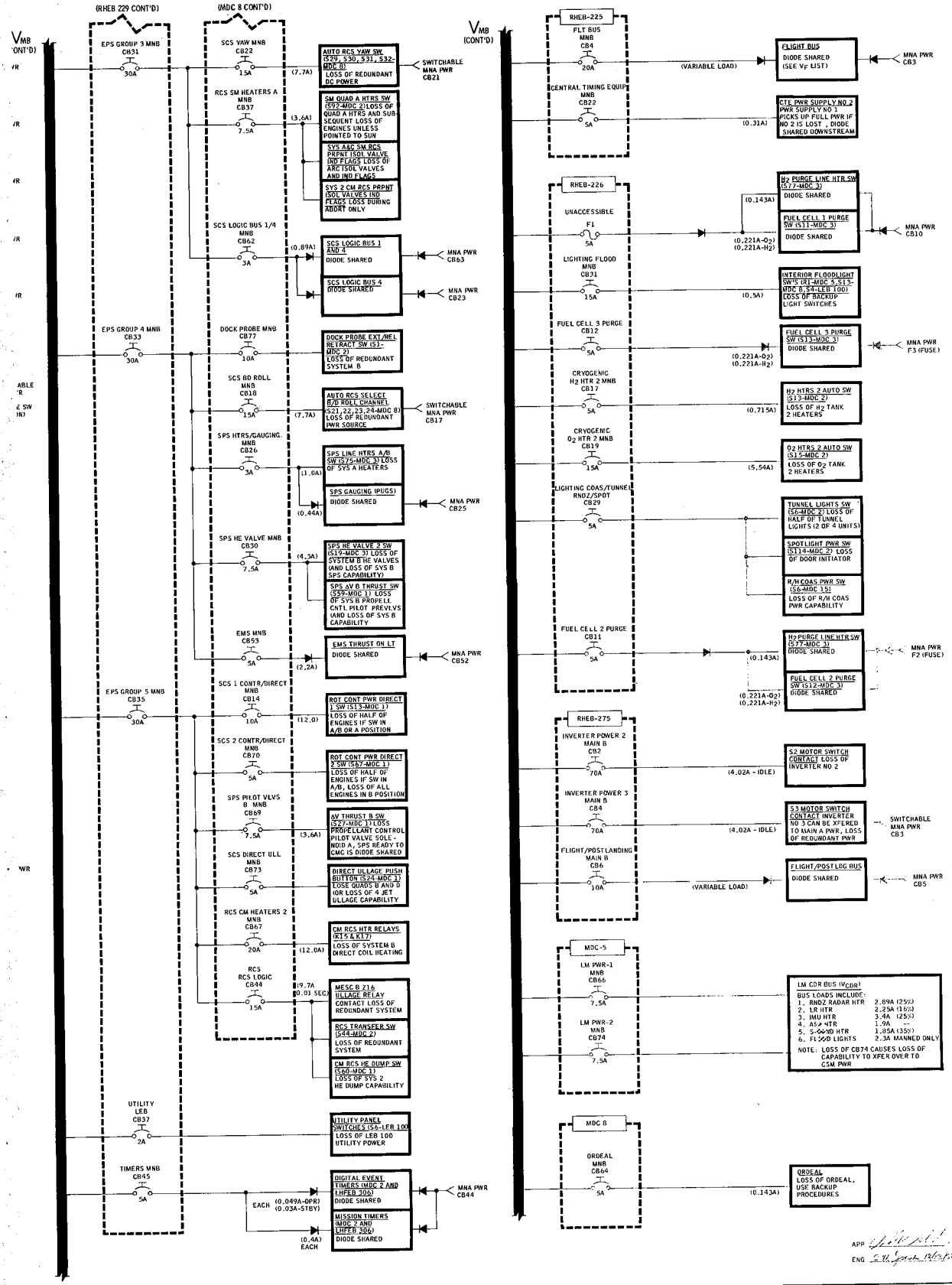
CORRECTIONS TO FIGURE 3.2, POWER DISTRIBUTION MATRIX, MAIN BUSES - Concluded

$V_{(MAIN\ BUS\ A\ OR\ B)}$	RHEB	MDC	CHANGE
	RHEB 229	MDC-8	
V_{MB}	CB33	CB26	FIRST ITEM SHOULD READ: SPS LINE HTRS A/B SW (S75-MDC 3) LOSS OF SYS B HEATERS
	CB35	CB14	SHOULD READ: ROT CONT PWR DIRECT 1 SW (S13-MDC 1) LOSS OF HALF OF DIRECT CONTROL IF SW IS IN A/B OR A POSITION
	CB35	CB70	CORRECT CB NUMBERED CB70 TO CB71, WHICH SHOULD NOW READ AS FOLLOWS: ROT CONT PWR DIRECT 2 SW (S67-MDC 1) LOSS OF HALF OF DIRECT CONTROL IF SW IN A/B POSITION; ALL, IF IN B POS.
	CB35	CB69	SHOULD READ: ΔV THRUST B SW (S59-MDC 1) LOSS OF PILOT VALVE SOLENOID B
	RHEB 229	MDC-8	
	CB35	CB73	SHOULD READ: DIRECT ULLAGE PUSH BUTTON (S24-MDC 1) LOSS OF QUADS A4 AND C3 OR LOSS OF 4 JET ULLAGE CAPABILITY.
	CB35	CB67	CORRECT CB NUMBERED CB67 TO CB66
	CB35	CB44	DELETE THIRD ITEM AND SUBSTITUTE THE FOLLOWING: CM RCS LOGIC SW (S46-MDC 1) LOSS OF RCS LOGIC BUS
	CB37		ADD AS A SECOND ITEM: UTILITY POWER SW (S6-MDC 16) SIDE HATCH AUX DUMP HTR
		CB64	DELETE THIS BREAKER, WHICH WAS MOVED TO TIE IN WITH RHEB 229, CB31


VMA
MAIN BUS A
SERVICE MODULE BUS A (V_{SMA})
BATTERY BUS A (V_{BA})
ENTRY BATTERY C
CC0206V MAIN BUS A VOLTS 0 TO 45 VDC 10 S/S 1 S/S
MDC 5
EPS SENSOR SIGNAL MNA CB1 5A
(0.009A)
DC UNDERVOLTAGE SENSING UNIT LOSS OF SENSING CAPABILITY FOR MNA UNDERVOLTAGE
DC INDICATORS SW LOSS OF ONBOARD VOLTAGE READOUT OF MNA
BATTERY CHARGER MNA CB16 5A
(1.75A)
K1 RELAY CONTACT DC PWR DIODE SHARED
AC1/AC2 SWITCHABLE PWR
MNB PWR CB17
INSTRUMENTS ESS MNA CB19 15A
(0.86A-CM) (3.6A-SM)
INSTR PWR CONTROL OPERATIONAL CIRCUIT BREAKERS (RHEB-276) CB1, 2, 3 & 4 DIODE SHARED
MNB PWR CB20
ECS POT H_2O HTR MNA CB26 5A
(1.61A)
POT H2O HTR SW (S42-MDC 2) LOSS OF REDUNDANT DC PWR SOURCE
SWITCHABLE MNB PWR CB27
(0.15A)
GLYCOL EVAP H2O FLOW SW (S58-MDC 2) DIODE SHARED
MNB PWR CB27
ECS H_2O ACCUM MNA CB28 5A
(0.092A-AUTO) (0.084A-MAN)
SUIT CIRCUIT H2O ACCUM SW (S51-MDC 2) LOSS OF AUTOMATIC OPERATION OF ACCUM NO 1 (SWITCH TO ACCUM NO 2 OR OPERATE NO 1 MANUALLY)
ECS TRANSDUCER WASTE POT H_2O MNA CB30 5A
(0.08A)
POT H2O TANK QUANTITY SENSOR DIODE SHARED
WASTE H2O TANK QUANTITY SENSOR DIODE SHARED
MNB PWR CB31
ECS TRANSDUCER PRESS GROUPS 1 MNA CB32 5A
(0.115A)
SUIT MANIF PRESSURE SENSOR DIODE SHARED
SUIT TO CABIN O2 DIFF PRESS SENSOR DIODE SHARED
PRIM GLYCOL PUMP OUT PRESS SENSOR DIODE SHARED
PRIM GLYCOL ACCUM QUANTITY SENSOR DIODE SHARED
MNB PWR CB33
ECS TRANSDUCER PRESS GROUPS 2 MNA CB34 5A
(0.29A)
GLYCOL EVAP STEAM PRESS SENSOR DIODE SHARED
O2 SUPPLY MANIF PRESS SENSOR DIODE SHARED
CABIN PRESSURE SENSOR DIODE SHARED
CO2 PARTIAL PRESSURE SENSOR DIODE SHARED
O2 FLOW RATE SENSOR DIODE SHARED
MNB PWR CB35
ECS TRANSDUCER TEMP MNA CB36 5A
(0.35A)
TEMP XDUCER POWER SUPPLY DIODE SHARED, SUPPLIES POWER TO PRIM GLYCOL EVAP OUT TEMP (TM AND ONBOARD), SEC GLYCOL EVAP OUT TEMP (TM AND ONBOARD), GLYCOL EVAP STEAM OUT TEMP (TM), ECS RAD OUT TEMP (TM, C&W AND ONBOARD METER)
(0.07A)
CABIN TEMP SENSOR DIODE SHARED
MNB PWR CB37
ECS SECONDARY COOLANT LOOP XDUCERS MNA CB46 5A
(0.09A)
SEC GLYCOL ACCUM QUANTITY SENSOR DIODE SHARED
SEC GLYCOL PUMP OUT PRESS SENSOR DIODE SHARED
SEC EVAP OUT PRESSURE SENSOR DIODE SHARED
MNB PWR CB47
ECS WASTE H_2O/URINE DUCT HTR MNA CB50 5A
(0.21A)
URINE DUMP HTR SW (S4-LEB 101) LOSS OF SYS A URINE DUMP HTR (MNB HTR OFF CB51)
(0.12A)
STEAM DUCT HTR LOSS OF SYS A STEAM DUCT HTR (MNB HTR OFF CB51)
(CONT'D NEXT COLUMN)
(MDC 5 CONT'D)
VMA
(CONT'D)
C&W MNA CB52 10A
G&N IMU MNA CB56 25A
G&N IMU HTR MNA CB58 7.5A
G&N COMPUTER MNA CB60 10A
G&N OPTICS MNA CB62 10A
ECS RADIATORS CONT HTRS MNA CB67 5A
ECS SECONDARY COOLANT RAD HTR MNA CB71 5A
RHEB-229
EPS GROUP 1 MNA CB26 30A
EPS GROUP 2 MNA CB28 30A
(CONT'D NEXT COLUMN)


(RHEB 229 CONT'D)
(MDC 8 CONT'D)
MA (CONT'D)
VMA (CONT'D)
EPS GROUP 3 MNA CB30 30A
EPS GROUP 4 MNA CB32 30A
EPS GROUP 5 MNA CB34 30A
SCS YAW MNA CB21 15A
RCS SM HEATERS B MNA CB39 7.5A
SCS LOGIC BUS 1/2 MNA CB63 3A
DOCK PROBE MNA CB76 10A
SCS RD ROLL MNA CB17 15A
SPS HTRS/GAUGING MNA CB25 3A
SPS HE VALVE MNA CB29 7.5A
EMS MNA CB52 5A
SCS CONTR/DIRECT 1 MNA CB13 10A
SCS CONTR/DIRECT 2 MNA CB70 5A
SPS PILOT VLVS A-MNA CB68 7.5A
SCS DIRECT ULL MNA CB72 5A
RCS CM HEATERS 1 MNA CB67 20A
RCS RCS LOGIC CB43 15A
UTILITY R/L STA CB36 2A
TIMERS MNA CB44 5A
AUTO RCS YAW SW (S29,S30,S31,S32-MDC 8) LOSS OF REDUNDANT DC PWR
SWITCHABLE MNB PWR CB22
SM QUAD B HTRS SW (S94-MDC 2) LOSS OF QUAD B HEATERS AND SUBSEQUENT LOSS OF ENGINES UNLESS POINTED TO SUN
SYS B&D SM RCS PRPLNT ISOL VALVE IND FLAGS LOSS OF B&D VALVES AND FLAGS
SYS 1 CM RCS PRPLNT ISOL VALVES & IND FLAGS LOSS OF SYS 1 VALVES AND FLAGS
LOGIC POWER 2/3 SW (S10-MDC 7) LOSS OF REDUNDANT POWER TO SCS LOGIC BUS 2
SCS LOGIC BUS 1 DIODE SHARED
MNB PWR CB62
DOCK PROBE EXT/RET RETRACT SW (S1-MDC 2) LOSS OF REDUNDANT SYSTEM A
AUTO RCS SELECT B/D ROLL CHANNEL (S21,22,23,24-MDC 8) LOSS OF REDUNDANT DC PWR
SWITCHABLE MNB PWR CB18
SPS LINE HTRS A/B SW (S75-MDC 3) LOSS OF SYS B HEATERS
SPS GAUGING (PUGS) DIODE SHARED
MNB PWR CB26
SPS HE VALVE 1 SW (S18-MDC 3) LOSS OF SYS A HE VLVS (AND LOSS OF SPS SYS A)
SPS AV A THRUST SW (S26-MDC 1) LOSS OF SYS A PROPELL CNTL PILOT PREVLVS (AND LOSS OF SPS SYS A)
EMS THRUST ON LT DIODE SHARED
MNB PWR CB53
ROT CONT PWR DIRECT 1 SW (S13-MDC 1) LOSS OF HALF OF ENGINES IF SW IN A/B POSITION ALL ENGINES IF IN A POS
ROT CONT PWR DIRECT 2 SW (S67-MDC 1) LOSS HALF OF ENGINES IF SW IN A/B POSITION ALL ENGINES IF IN A POS
AV THRUST A SW (S26-MDC 1) LOSS OF PRPLNT CONTROL PILOT VALVE SOLENOID A, SPS READY TO CMC IS DIODE SHARED
DIRECT ULLAGE PUSH BUTTON (S74-MDC 1) LOSS QUADS A4 AND C3 (OR LOSS OF 4 JET ULLAGE CAPABILITY
CM RCS HTR RELAYS (K15 & K17) LOSS OF SYSTEM A DIRECT COIL HEATING
RCS TRANSFER SW (S44-MDC 2) LOSS OF REDUNDANT SYSTEM
MESC A 2 16 ULLAGE CONTACT LOSS OF REDUNDANT SYSTEM
CM RCS HE DUMP SW (S60-MDC 1) LOSS OF CM RCS SYS 1 HE DUMP CAPABILITY
UTILITY PANEL SWITCHES (S5-MDC 15) (S3-MDC 16) LOSS OF UTILITY POWER TO CAMERA ON MDC 15 AND 16
MISSION TIMERS (MDC 2 AND LHEB 306) DIODE SHARED
EVENT TIMERS (MDC 1 AND LHEB 306) DIODE SHARED
MNB PWR CB45
EACH (0.049A-OP) (0.03A-STB)
RHEB-225
FLT BUS MNA CB3 20A
CENTRAL TIMING EQUIP MNA CB21 5A
(VARIABLE LOAD)
(0.31A)
RHEB-226
FUEL CELL 1 PURGE CB10 5A
LIGHTING FLOOD MNA CB30 15A
UNACCESSIBLE F3 5A
CRYOGENIC H_2 HTR 1 MNA CB16 5A
CRYOGENIC O_2 HTR 1 MNA CB18 15A
LIGHTING COAS/TUNNEL RNDZ/SPOT CB28 5A
UNACCESSIBLE F2 5A
RHEB-275
INVERTER POWER 1 MAIN A CB1 70A
INVERTER POWER 3 MAIN A CB3 70A
FLIGHT/POSTLANDING MAIN A CB5 10A
(4.02A-IDLE)
(4.02A-IDLE)
(VARIABLE LOAD)
(0.268A)
C&W SWITCHES (S7,59,379 MDC-2) (S9-MDC 3KS1-MDC 1) AND (A4-LEB122) AND LAMP DRIVERS DIODE SHARED
MNB PWR CB53
POWER SERVO ASS'Y (PSA) DIODE SHARED
MNB PWR CB57
(2.9A)
POWER SERVO ASS'Y (PSA) DIODE SHARED
MNB PWR CB59
(0.54A-STBY) (2.5A-OPER)
COMMAND MODULE COMPUTER (CMC) DIODE SHARED
MNB PWR CB61
(0.98A-NBA) (0.69A-CDU) (1.44A-PSA)
G&N POWER OPTICS SW (S1-LEB 100) DIODE SHARED
MNB PWR CB63
(0.10A)
ECS RADIATORS FLOW CONTROL SW (S85-MDC 2) SWITCHES TO SEC RAD FLOW CONTROLLER, LOSS OF PRI FLOW CONTROLLER
(0.34A)
ECS RADIATORS HTR SW (S87-MDC 2) IF SW IN PRIM 1 NOTHING LOST IF SW IN PRIM 2 HTRS LOST
SWITCHABLE MN B PWR CB78 (CHANGE SW POSITION)
(0.50A)
ECS RADIATORS HTR SW SEC (S88-MDC 2) LOSS OF SEC COOLANT LOOP HTR CONTROL LOGIC AND SEC RAD IN & OUT TEMPS (TM AND ONBOARD)
MDC B
SCS PITCH MNA CB19 15A
(7.7A)
AUTO RCS SELECT PITCH SWITCHES (S25, S26,S27,S28-MDC 8) LOSS OF REDUNDANT DC PWR SOURCE FOR RCS PITCH MANEUVERS
SWITCHABLE MNB PWR CB20
SCS LOGIC BUS 3/4 MNA CB23 3A
(1.7A)
LOGIC POWER 2/3 SW (S10-MDC 7) LOSS OF REDUNDANT POWER TO SCS LOGIC BUS 3
SCS LOGIC BUS 4 DIODE SHARED
MNB PWR CB62
RCS SM HEATERS D MNA CB40 7.5A
(1.42A)
SM QUAD D HTRS SW (S95-MDC 8) LOSS OF QUAD D HEATERS AND SUBSEQUENT LOSS OF ENGINES UNLESS POINTED TO SUN
RCS PRPLNT ISOL MNA CB41 10A
(4.0A)
CM RCS PRPLNT SW (S45-MDC 2) LOSS OF SYS 1 CM RCS
SM RCS SYS B&D PRPLNT ISOL VALVES (PRIM AND SEC) LOSS OF SM BANK B AND D RCS
SCS CONTR/AUTO MNA CB74 3A
(0.086A)
ROT CONT 1 PWR SW (S64-MDC 1) DIODE SHARED
ROT CONT 2 PWR SW (S65-MDC 1) DIODE SHARED
MNB PWR CB75
(0.086A)
TRANS CONT PWR SW (S66-MDC 1) MAIN BUS B PICKS UP LOAD IF MNA LOST
AUTO RCS ENABLE RELAY SEQ A SYS LOSS OF SYS A AUTO RCS ENABLE SIGNAL
SCS SYSTEM MNA CB11 15A
(11.9A)
SCS FDAI/GPI POWER SW (S3-MDC 7) LOSS OF FDAI NO 1 AND GPI NO 1
(2.0A)
BMAG PWR SW (S6-MDC 7) LOSS OF GYRO ASSY NO 1 ATT ERROR & TEMP CNTL, SMRD TM & TEMP ALARM
SCS TVC SERVO 1 PWR SW (S7-MDC 7) LOSS OF REDUNDANT DC PWR
SWITCHABLE MNB PWR CB12
SCS TVC SERVO 2 PWR SW (S9-MDC 7) LOSS OF REDUNDANT DC PWR
SWITCHABLE MNB PWR CB12
SCS ELECTRONICS PWR SW (S5-MDC 7) LOSS OF COMPLETE GDC OPERATION
SCS AC ROLL MNA CB15 15A
(7.7A)
AUTO RCS SELECT A/C ROLL SWITCHES (S17, S18, S19, S20-MDC 8) LOSS OF REDUNDANT DC PWR
SWITCHABLE MNB PWR CB16
(CONT'D NEXT COLUMN)


VMB
MAIN BUS B
SERVICE MODULE BUS B (VSMB)
BATTERY BUS B (VBB)
ENTRY BATTERY C
CC0207V
MAIN BUS B VOLTS
0 TO 45 VDC
10 S/S
1 S/S
MDC 5
EPS SENSOR SIGNAL MNB CB2
5A
(0.009A)
DC UNDERVOLTAGE SENSING UNIT LOSS OF SENSING CAPABILITY FOR MNB UNDERVOLTAGE
DC INDICATORS SW LOSS OF ONBOARD VOLTAGE READOUT OF MNB VOLTAGE
BATTERY CHARGER MNB CB17
5A
(1.75A)
K1 RELAY CONTACT DC PWR DIODE SHARED
AC1/AC2 SWITCHABLE PWR
MNA PWR CB16
INSTRUMENTS ESS MNB CB20
15A
(0.086A-CM)
(3.6A - SM)
INSTR PWR CONTROL OPERATIONAL CIRCUIT BREAKERS (RHEB-276) CB1, 2, 3 & 4 DIODE SHARED
MNA PWR CB19
ECS POT H2O HTR MNB CB27
5A
(1.61A)
POT H2O HTR SW (S42-MDC 2) LOSS OF REDUNDANT DC PWR SOURCE
SWITCHABLE MN A PWR CB26
(0.15A)
GLYCOL EVAP H2O FLOW SW (S58-MDC 2) DIODE SHARED
MNA PWR CB26
ECS H2O ACCUM MNB CB29
5A
(0.092A-AUTO)
(0.084A-MAN)
SUIT CIRCUIT H2O ACCUM SW (S51-MDC 2) LOSS OF AUTOMATIC OPERATION OF ACCUM NO 2 (SWITCH TO ACCUM NO 1, OR OPERATE NO 2 MANUALLY
ECS TRANSDUCER WASTE/POT H2O MNB CB31
5A
(0.08A)
POT H2O TANK QUANTITY SENSOR DIODE SHARED
WASTE H2O TANK QUANTITY SENSOR DIODE SHARED
MNA PWR CB30
ECS TRANSDUCER PRESS GROUP 1 MNB CB33
5A
(0.115A)
SUIT MANIF PRESSURE SENSOR DIODE SHARED
SUIT TO CABIN D2 DIFF PRESS SENSOR DIODE SHARED
PRIM GLYCOL PUMP OUT PRESS SENSOR DIODE SHARED
PRIM GLYCOL ACCUM QUANTITY SENSOR DIODE SHARED
MNA PWR CB32
ECS TRANSDUCER PRESS GROUP 2 MNB CB35
5A
(0.29A)
GLYCOL EVAP STEAM PRESS SENSOR DIODE SHARED
O2 SUPPLY MANIF PRESS SENSOR DIODE SHARED
CABIN PRESSURE SENSOR DIODE SHARED
CO2 PARTIAL PRESSURE SENSOR DIODE SHARED
O2 FLOW RATE SENSOR DIODE SHARED
MNA PWR CB34
ECS TRANSDUCER TEMP MNB CB37
5A
(0.35A)
(0.07A)
TEMP XDUCER POWER SUPPLY DIODE SHARED, SUPPLIES POWER TO PRIM GLYCOL EVAP OUT TEMP (TM & ONBOARD), SEC GLYCOL EVAP OUT TEMP (TM & ONBOARD), GLYCOL EVAP STEAM OUT TEMP (TM), ECS RAD OUT TEMP (TM, C&W AND ONBOARD METER)
CABIN TEMP SENSOR DIODE SHARED
MNA PWR CB36
ECS SECONDARY COOLANT LOOP XDUCERS MNB CB47
5A
(0.09A)
SEC GLYCOL ACCUM QUANTITY SENSOR DIODE SHARED
SEC GLYCOL PUMP OUT PRESS SENSOR DIODE SHARED
SEC EVAP OUT PRESSURE SENSOR DIODE SHARED
MNA PWR CB46
ECS WASTE H2O/URINE DUCT HTR MNB CB51
5A
(0.21A)
(0.21A)
URINE DUMP HTR SW (S4-LEB 101) LOSS OF SYS B URINE DUMP HTR (MNA HTR OFF CB50)
STEAM DUCT HTR LOSS OF SYS B STEAM DUCT HTR (MNA HTR OFF CB50)
(CONT'D NEXT COLUMN)
(MDC 5 CONT'D)
VMB
(CONT'D)
C&W MNB CB53
10A
(0.268A)
C&W SWITCHES (S7, S9, S79 MDC-2) (S9-MDC 3) (S1-MDC 1) AND (A4-LEB122) AND CAMP DRIVERS DIODE SHARED
G&N IMU MNB CB57
25A
POWER SERVO ASS'Y (PSA) DIODE SHARED
G&N IMU HTR MNB CB59
7.5A
(2.9A)
POWER SERVO ASS'Y (PSA) DIODE SHARED
G&N COMPUTER MNB CB61
10A
(0.54A - STBY)
(2.5A - OPER)
COMMAND MODULE COMPUTER (CMC) DIODE SHARED
G&N OPTICS MNB CB63
10A
(0.98A - NBA)
(0.69A - CDU)
(1.44A - PSA)
G&N POWER OPTICS SW (S1-LEB 100) DIODE SHARED
ECS RADIATORS CONT HTRS MNB CB70
5A
(0.10A)
ECS RADIATORS FLOW CONTROL SW (S85-MDC 2) LOSS OF SEC FLOW CONTROLLER
(0.34A)
ECS RADIATORS HTR SW (S87-MDC 2) IF SW IN PRIM 1 RAD IN TEMP (TM AND METER) AND HTRS LOST, IS SW IN PRIM 2 ONLY RAD IN TEMP LOST
RHEB-229
EPS GROUP 1 MNB CB27
30A
MDC 8
SCS PITCH MNB CB20
15A
(7.7A)
AUTO RCS SELECT PITCH SWITCHES (S25, S26, S27, S28-MDC 8) LOSS OF REDUNDANT PWR SOURCE FOR RCS PITCH MANEUVERS
SCS LOGIC BUS 2/3 MNB CB24
3A
(1.8A)
LOGIC POWER 2/3 SW (S10-MDC 7) LOSS OF REDUNDANT POWER TO LOGIC BUS 2 & 3
RCS SM HEATERS C MNB CB38
7.5A
(1.42A)
SM QUAD C HTRS SW (S93-MDC 8) LOSS OF QUAD C HEATERS AND SUBSEQUENT LOSS OF ENGINES UNLESS POINTED TO SUN
RCS PRPLNT ISOL MNB CB42
10A
(4.0A)
CM RCS PRPLNT SW (S46-MDC 2) LOSS OF SYSTEM 2 CM RCS
SM RCS SYS A&C PRPLNT ISOL VALVES (PRIM & SEC) LOSS OF SM BANK A AND C RCS
SCS CONTR/AUTO MNB CB75
3A
(0.086A)
ROT CONT 1 PWR SW (S64-MDC 1) DIODE SHARED
(0.086A)
ROT CONT 2 PWR SW (S65-MDC 1) DIODE SHARED
TRANS CONT PWR SW (S66-MDC 1) MAIN BUS A PICKS UP LOAD IF MN B LOST
AUTO RCS ENABLE RELAY SEQ B SYS LOSS OF SYS B AUTO RCS ENABLE SIGNAL
EPS GROUP 2 MNB CB29
30A
(CONT'D NEXT COLUMN)
SCS SYSTEM MNB CB12
15A
(12.2A)
SCS FDAI/GPI POWER SW (S3-MDC 7) LOSS OF FDAI NO 2 AND GPI NO 2
SCS ELECTRONICS PWR SW (S5-MDC 7) LOSS OF COMPLETE GDC OPERATION
SCS TVC SERVO 1 PWR SW (S8-MDC 7) LOSS OF REDUNDANT DC PWR
SCS TVC SERVO 2 PWR SW (S9-MDC 7) LOSS OF REDUNDANT DC PWR
(2.0A)
RMAG PWR SW (S7-MDC 7) LOSS OF GYRO ASSEMBLY NO 2
SCS AC ROLL MNB CB16
15A
(7.7A)
AUTO RCS SELECT A/C ROLL SWITCHES (S17, S18, S19, S20-MDC 8) LOSS OF REDUNDANT DC PWR
(CONT'D NEXT COLUMN)
MNB PWR CB4
MNB PWR F1 (FUSE)
MNB PWR CB12
MNB PWR CB11
SWITCHABLE MNB PWR CB4
MNB PWR CB6



APP
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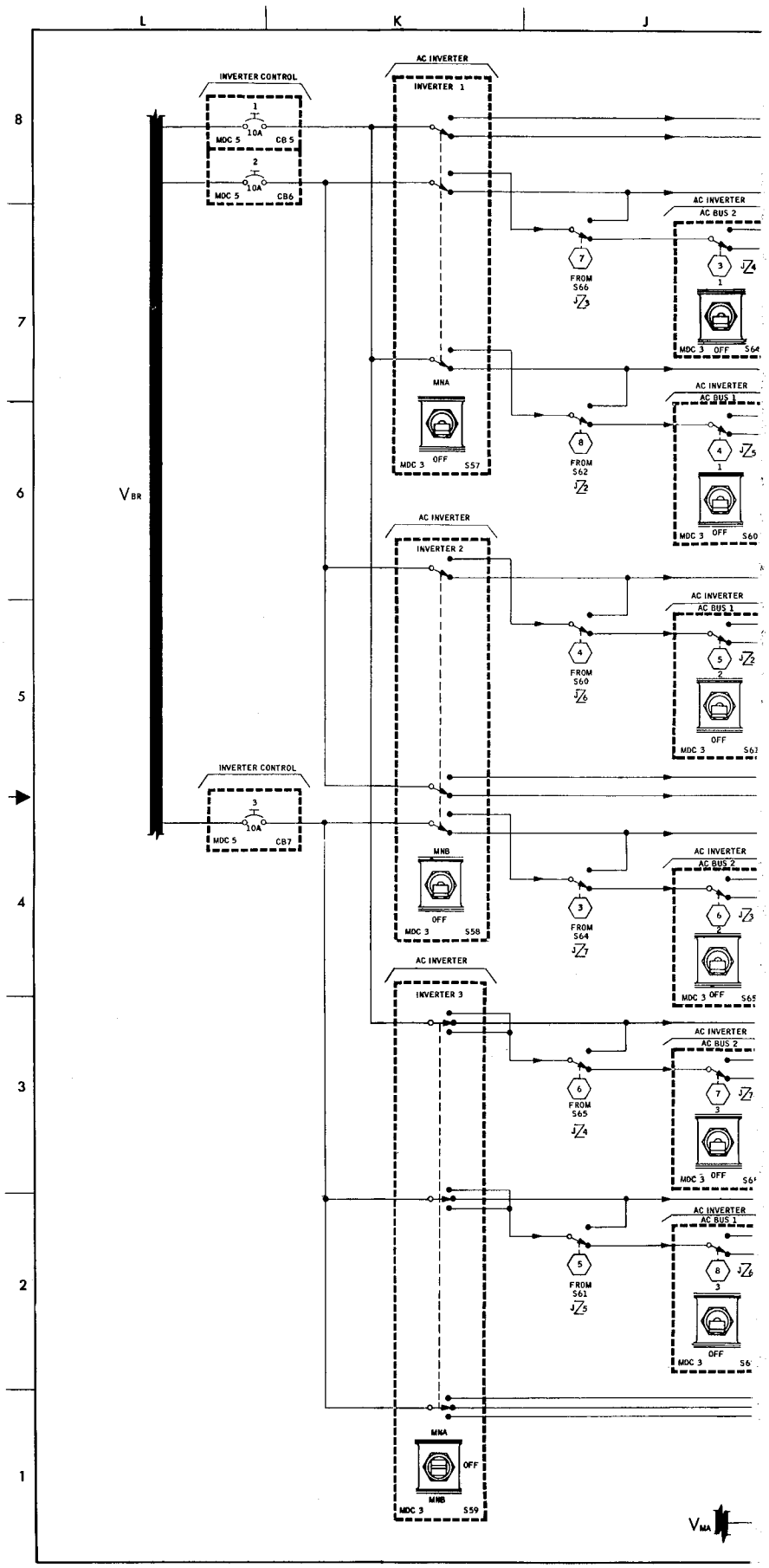
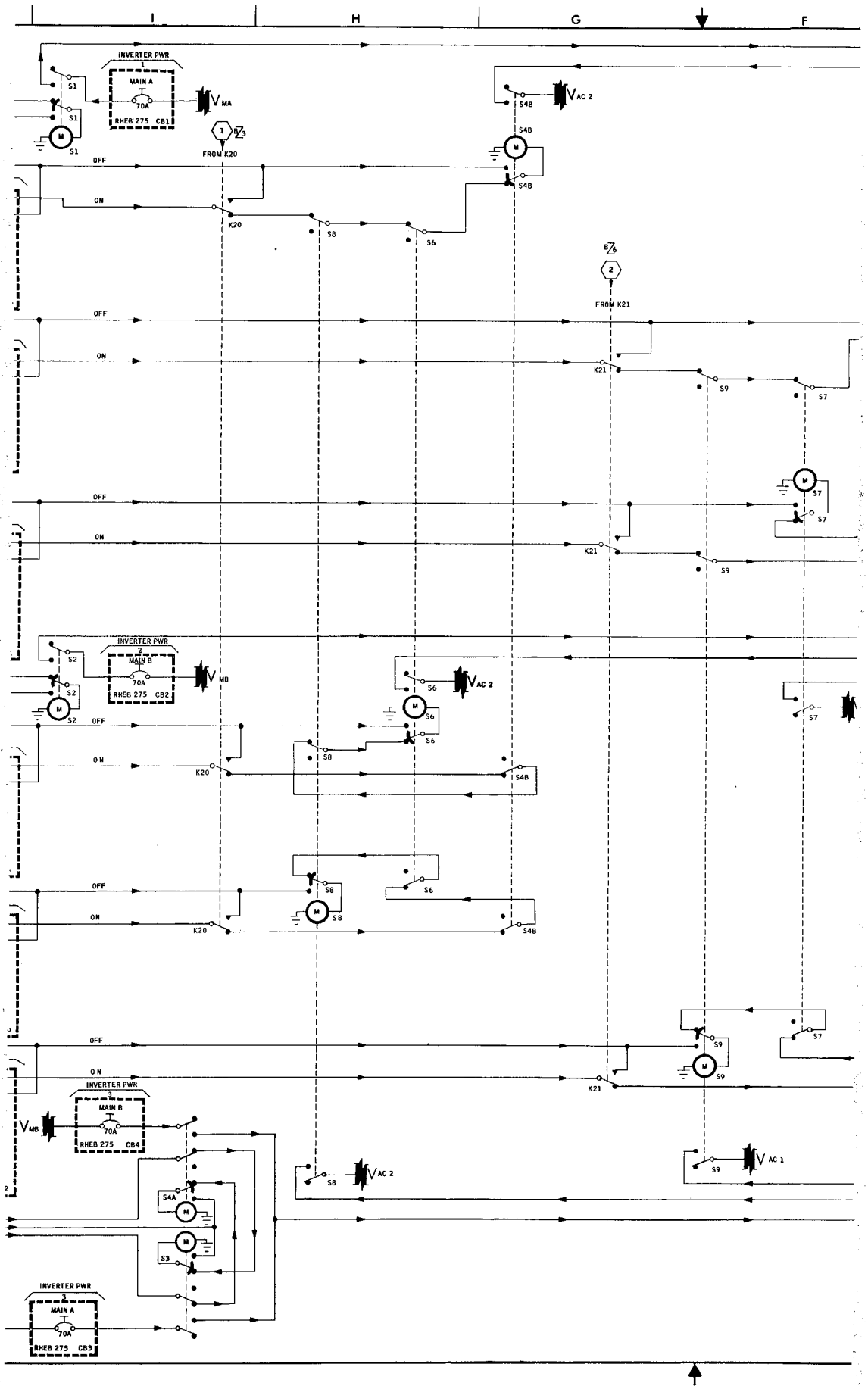
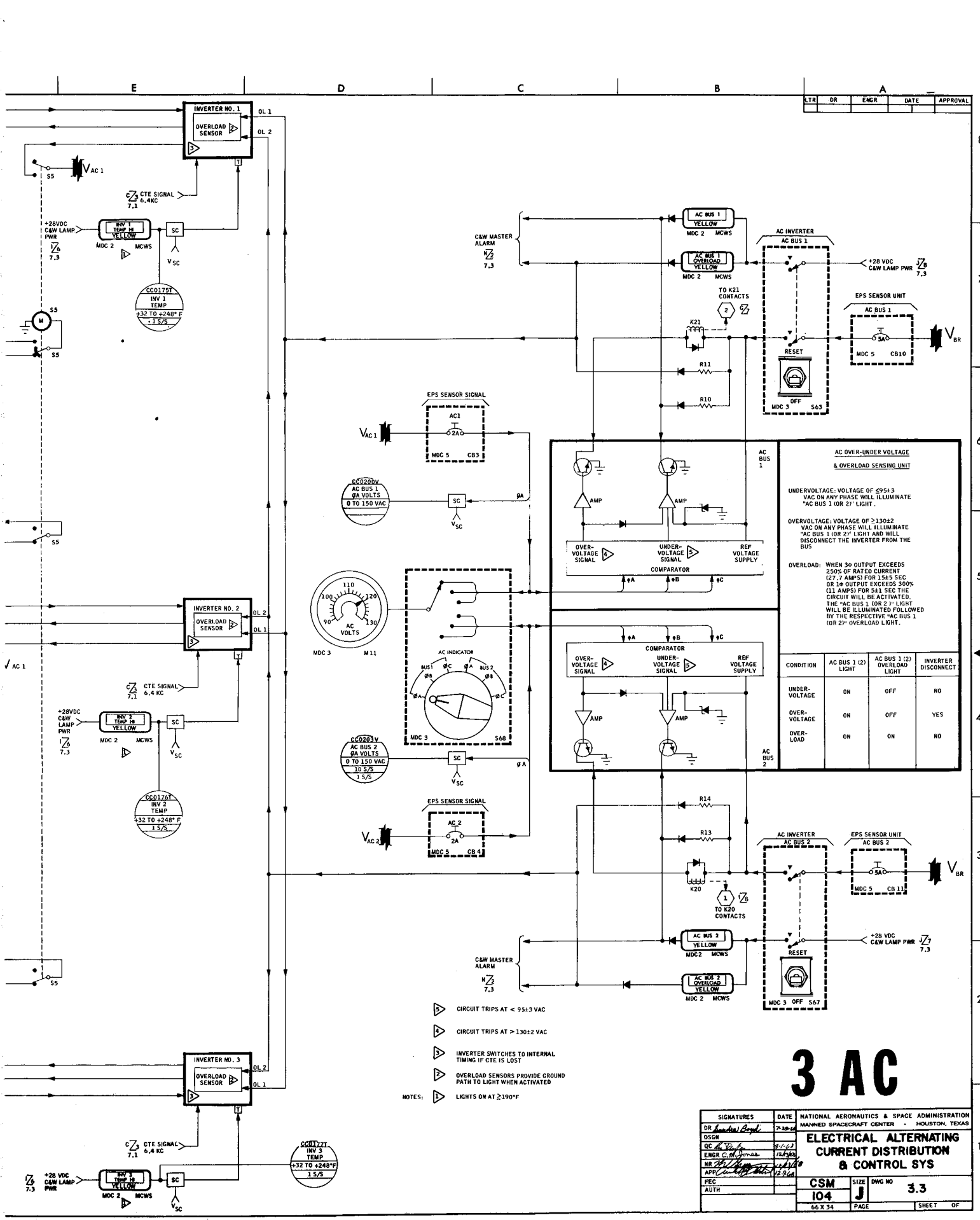
POWER DISTRIBUTION MATRIX MAIN BUSES

CSM 104	DWG NO FIGURE 3.2
	PAGE SHEET OF


L
K
J
8
7
6
5
4
3
2
1
INVERTER CONTROL
1
10A
MDC 5
CB 5
2
10A
MDC 5
CB6
3
10A
MDC 5
CB7
AC INVERTER
INVERTER 1
INVERTER 2
INVERTER 3
MNA
MNB
OFF
MDC 3
S57
S58
S59
V_{BR}
V_{MA}
AC BUS 2
AC BUS 1
FROM S66
FROM S62
FROM S60
FROM S64
FROM S65
FROM S61
MDC 3 OFF S64
MDC 3 OFF S60
MDC 3 OFF S65
OFF


I
H
G
F
INVERTER PWR 1
MAIN A
70A
RHEB 275 CB1
S1
M
S1
S1
VMA
1
FROM K20
OFF
ON
K20
S8
S6
S4B
VAC 2
S4B
M
S4B
2
FROM K21
OFF
ON
K21
S9
S7
M
S7
S7
OFF
ON
K21
S9
INVERTER PWR 2
MAIN B
70A
RHEB 275 CB2
S2
M
S2
S2
VMB
OFF
ON
K20
S8
S6
VAC 2
S6
M
S6
S4B
S7
OFF
ON
K20
S8
M
S8
S6
S4B
OFF
ON
K21
S9
M
S9
S7
INVERTER PWR 3
MAIN B
70A
RHEB 275 CB4
VMB
S4A
M
M
S3
S8
VAC 2
S9
VAC 1
INVERTER PWR 3
MAIN A
70A
RHEB 275 CB3


INVERTER NO. 1
OVERLOAD SENSOR
OL 1
OL 2
S5
VAC 1
CTE SIGNAL 6.4KC
+28VDC C&W LAMP PWR
INV 1 TEMP HI YELLOW
MDC 2 MCWS
SC
VSC
CC0175T INV 1 TEMP +32 TO +248° F 1 S/S
M
INVERTER NO. 2
CC0176T INV 2 TEMP +32 TO +248° F 1 S/S
INVERTER NO. 3
CC0177T INV 3 TEMP +32 TO +248°F 1 S/S
C&W MASTER ALARM
AC BUS 1 YELLOW
AC BUS 1 OVERLOAD YELLOW
AC BUS 2 YELLOW
AC BUS 2 OVERLOAD YELLOW
AC INVERTER AC BUS 1
AC INVERTER AC BUS 2
+28 VDC C&W LAMP PWR
TO K21 CONTACTS
TO K20 CONTACTS
K21
K20
R11
R10
R14
R13
RESET
OFF
MDC 3 S63
MDC 3 OFF S67
EPS SENSOR UNIT AC BUS 1
EPS SENSOR UNIT AC BUS 2
MDC 5 CB10
MDC 5 CB 11
VBR
EPS SENSOR SIGNAL
AC1
AC2
2A
MDC 5 CB3
MDC 5 CB 4
CC0202V AC BUS 1 ØA VOLTS 0 TO 150 VAC 10 S/S 1 S/S
CC0203V AC BUS 2 ØA VOLTS 0 TO 150 VAC 10 S/S 1 S/S
AC VOLTS
MDC 3 M11
AC INDICATOR
MDC 3 S68
AC BUS 1
AC BUS 2
AMP
OVER-VOLTAGE SIGNAL
UNDER-VOLTAGE SIGNAL
REF VOLTAGE SUPPLY
COMPARATOR
AC OVER-UNDER VOLTAGE & OVERLOAD SENSING UNIT
UNDERVOLTAGE: VOLTAGE OF ≤95±3 VAC ON ANY PHASE WILL ILLUMINATE "AC BUS 1 (OR 2)" LIGHT.
OVERVOLTAGE: VOLTAGE OF ≥130±2 VAC ON ANY PHASE WILL ILLUMINATE "AC BUS 1 (OR 2)" LIGHT AND WILL DISCONNECT THE INVERTER FROM THE BUS
OVERLOAD: WHEN 3ø OUTPUT EXCEEDS 250% OF RATED CURRENT (27.7 AMPS) FOR 15±5 SEC OR 1ø OUTPUT EXCEEDS 300% (11 AMPS) FOR 5±1 SEC THE CIRCUIT WILL BE ACTIVATED. THE "AC BUS 1 (OR 2)" LIGHT WILL BE ILLUMINATED FOLLOWED BY THE RESPECTIVE "AC BUS 1 (OR 2)" OVERLOAD LIGHT.
CONDITION | AC BUS 1 (2) LIGHT | AC BUS 1 (2) OVERLOAD LIGHT | INVERTER DISCONNECT
UNDER-VOLTAGE | ON | OFF | NO
OVER-VOLTAGE | ON | OFF | YES
OVER-LOAD | ON | ON | NO
5 CIRCUIT TRIPS AT < 95±3 VAC
4 CIRCUIT TRIPS AT > 130±2 VAC
3 INVERTER SWITCHES TO INTERNAL TIMING IF CTE IS LOST
2 OVERLOAD SENSORS PROVIDE GROUND PATH TO LIGHT WHEN ACTIVATED
NOTES: 1 LIGHTS ON AT ≥190°F
3 AC
SIGNATURES | DATE
DR | DSGN | QC | ENGR | NR | APP | FEC | AUTH
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ELECTRICAL ALTERNATING CURRENT DISTRIBUTION & CONTROL SYS
CSM 104
SIZE J
DWG NO 3.3
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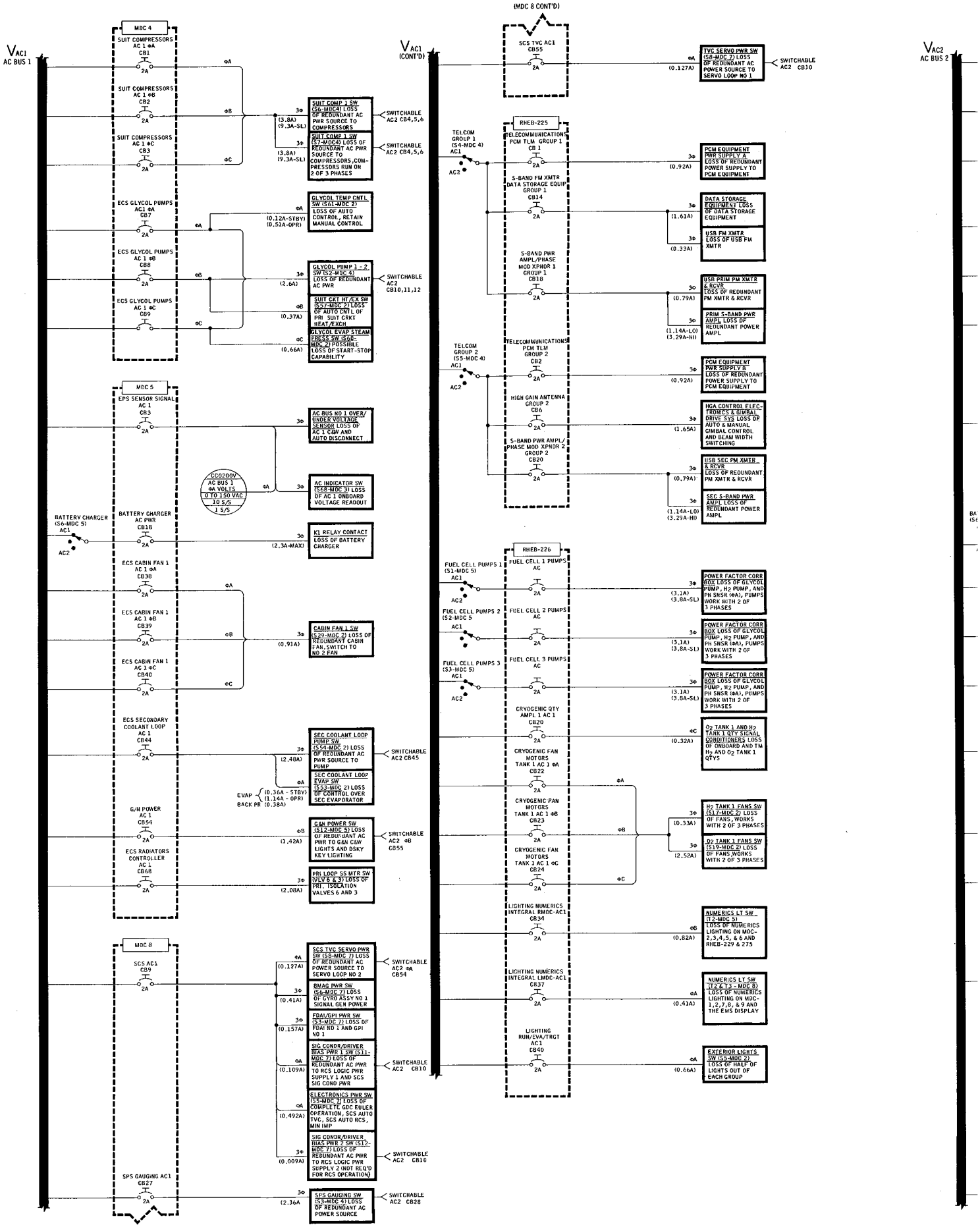
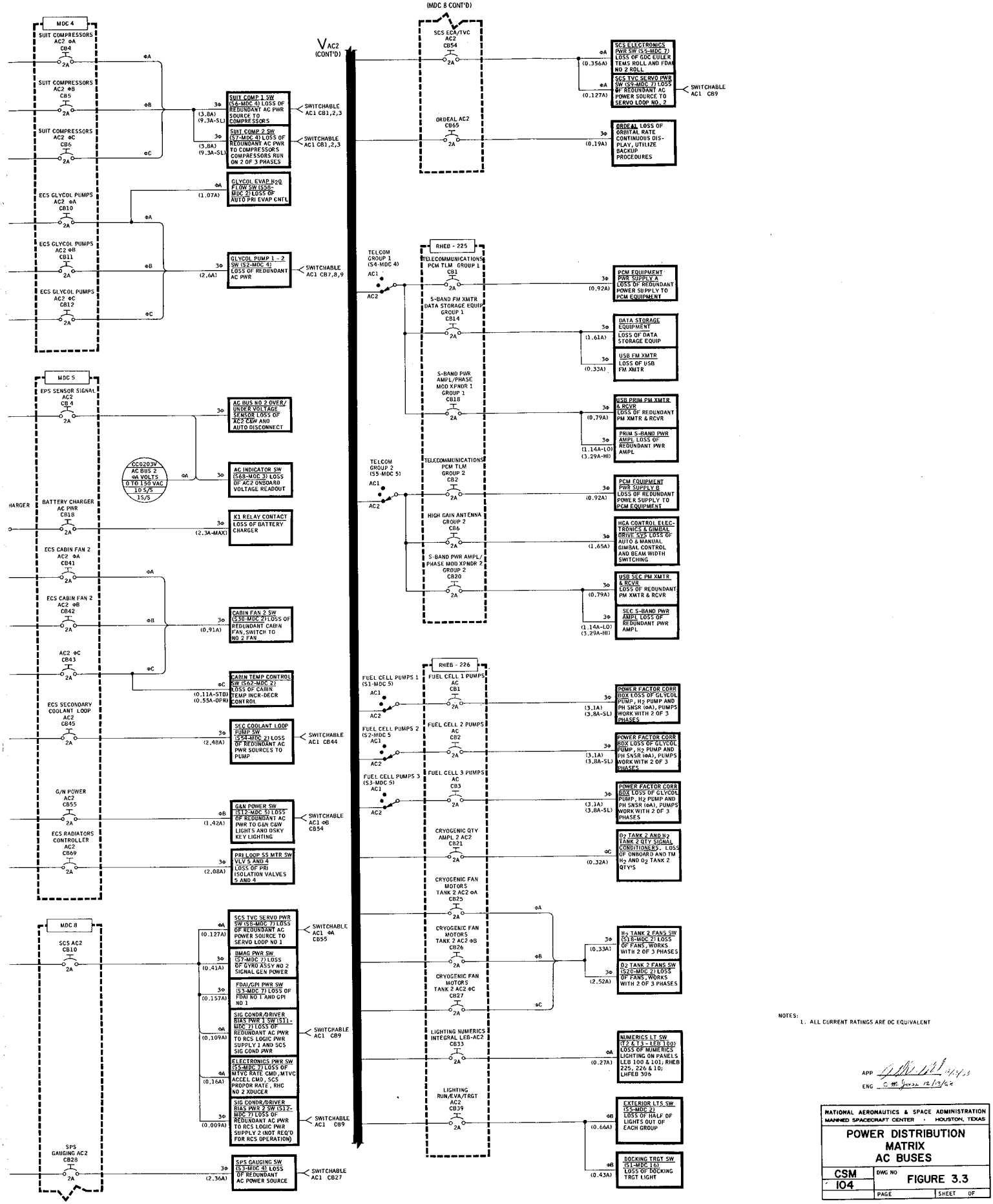

VAC1 AC BUS 1
MDC 4
SUIT COMPRESSORS AC 1 ΦA CB1
SUIT COMPRESSORS AC 1 ΦB CB2
SUIT COMPRESSORS AC 1 ΦC CB3
2A
ΦA
ΦB
ΦC
3Φ
(3.8A) (9.3A-SL)
SUIT COMP 1 SW (S6-MDC4) LOSS OF REDUNDANT AC PWR SOURCE TO COMPRESSORS
SWITCHABLE AC2 CB4,5,6
SUIT COMP 1 SW (S7-MDC4) LOSS OF REDUNDANT AC PWR SOURCE TO COMPRESSORS,COMPRESSORS RUN ON 2 OF 3 PHASES
SWITCHABLE AC2 CB4,5,6
ECS GLYCOL PUMPS AC1 ΦA CB7
ECS GLYCOL PUMPS AC 1 ΦB CB8
ECS GLYCOL PUMPS AC 1 ΦC CB9
(0.12A-STBY) (0.51A-OPR)
GLYCOL TEMP CNTL SW (S61-MDC 2) LOSS OF AUTO CONTROL, RETAIN MANUAL CONTROL
(2.6A)
GLYCOL PUMP 1 - 2 SW (S2-MDC 4) LOSS OF REDUNDANT AC PWR
SWITCHABLE AC2 CB10,11,12
(0.37A)
SUIT CKT HT/EX SW (S57-MDC 2) LOSS OF AUTO CNTL OF PRI SUIT CRKT HEAT/EXCH
(0.66A)
GLYCOL EVAP STEAM PRESS SW (S58-MDC 2) POSSIBLE LOSS OF START-STOP CAPABILITY
MDC 5
EPS SENSOR SIGNAL AC 1 CB3
AC BUS NO 1 OVER/UNDER VOLTAGE SENSOR LOSS OF AC 1 C&W AND AUTO DISCONNECT
CCO200V AC BUS 1 ΦA VOLTS 0 TO 150 VAC 10 S/S 1 S/S
AC INDICATOR SW (S68-MDC 3) LOSS OF AC 1 ONBOARD VOLTAGE READOUT
BATTERY CHARGER (S6-MDC 5) AC1 AC2
BATTERY CHARGER AC PWR CB18
(2.3A-MAX)
K1 RELAY CONTACT LOSS OF BATTERY CHARGER
ECS CABIN FAN 1 AC 1 ΦA CB38
ECS CABIN FAN 1 AC 1 ΦB CB39
ECS CABIN FAN 1 AC 1 ΦC CB40
(0.91A)
CABIN FAN 1 SW (S29-MDC 2) LOSS OF REDUNDANT CABIN FAN, SWITCH TO NO 2 FAN
ECS SECONDARY COOLANT LOOP AC 1 CB44
(2.48A)
SEC COOLANT LOOP PUMP SW (S54-MDC 2) LOSS OF REDUNDANT AC PWR SOURCE TO PUMP
SWITCHABLE AC2 CB45
EVAP (0.36A - STBY) (1.14A - OPR)
BACK PR (0.38A)
SEC COOLANT LOOP EVAP SW (S53-MDC 2) LOSS OF CONTROL OVER SEC EVAPORATOR
G/N POWER AC 1 CB54
ECS RADIATORS CONTROLLER AC 1 CB68
(1.42A)
G&N POWER SW (S12-MDC 5) LOSS OF REDUNDANT AC PWR TO G&N C&W LIGHTS AND DSKY KEY LIGHTING
SWITCHABLE AC2 ΦB CB55
(2.08A)
PRL LOOP SS MTR SW (VLV 6 & 3) LOSS OF PRL ISOLATION VALVES 6 AND 3
MDC 8
SCS AC1 CB9
(0.127A)
SCS TVC SERVO PWR SW (S8-MDC 7) LOSS OF REDUNDANT AC POWER SOURCE TO SERVO LOOP NO 2
SWITCHABLE AC2 ΦA CB54
(0.41A)
BMAG PWR SW (S6-MDC 7) LOSS OF GYRO ASSY NO 1 SIGNAL GEN POWER
(0.157A)
FDAI/GPI PWR SW (S5-MDC 7) LOSS OF FDAI NO 1 AND GPI NO 1
(0.109A)
SIG CONDR/DRIVER BIAS PWR 1 SW (S1)-MDC 7) LOSS OF REDUNDANT AC PWR TO RCS LOGIC PWR SUPPLY 1 AND SCS SIG COND PWR
SWITCHABLE AC2 CB10
(0.492A)
ELECTRONICS PWR SW (S5-MDC 7) LOSS OF COMPLETE GDC EULER OPERATION, SCS AUTO TVC, SCS AUTO RCS, MIN IMP
(0.009A)
SIG CONDR/DRIVER BIAS PWR 2 SW (S12-MDC 7) LOSS OF REDUNDANT AC PWR TO RCS LOGIC PWR SUPPLY 2 (NOT REQ'D FOR RCS OPERATION)
SWITCHABLE AC2 CB10
SPS GAUGING AC1 CB27
(2.36A)
SPS GAUGING SW (S3-MDC 4) LOSS OF REDUNDANT AC POWER SOURCE
SWITCHABLE AC2 CB28
VAC1 (CONT'D)
(MDC 8 CONT'D)
SCS TVC AC1 CB55
(0.127A)
TVC SERVO PWR SW (S8-MDC 7) LOSS OF REDUNDANT AC POWER SOURCE TO SERVO LOOP NO 1
SWITCHABLE AC2 CB10
RHEB-225
TELCOM GROUP 1 (S4-MDC 4) AC1 AC2
TELECOMMUNICATIONS PCM TLM GROUP 1 CB 1
(0.92A)
PCM EQUIPMENT PWR SUPPLY A LOSS OF REDUNDANT POWER SUPPLY TO PCM EQUIPMENT
S-BAND FM XMTR DATA STORAGE EQUIP GROUP 1 CB14
(1.61A)
DATA STORAGE EQUIPMENT LOSS OF DATA STORAGE EQUIPMENT
(0.33A)
USB FM XMTR LOSS OF USB FM XMTR
S-BAND PWR AMPL/PHASE MOD XPNDR 1 GROUP 1 CB18
(0.79A)
USB PRIM PM XMTR & RCVR LOSS OF REDUNDANT PM XMTR & RCVR
(1.14A-LO) (3.29A-HI)
PRIM S-BAND PWR AMPL LOSS OF REDUNDANT POWER AMPL
TELCOM GROUP 2 (S5-MDC 4) AC1 AC2
TELECOMMUNICATIONS PCM TLM GROUP 2 CB2
(0.92A)
PCM EQUIPMENT PWR SUPPLY B LOSS OF REDUNDANT POWER SUPPLY TO PCM EQUIPMENT
HIGH GAIN ANTENNA GROUP 2 CB6
(1.65A)
HGA CONTROL ELECTRONICS & GIMBAL DRIVE SYS LOSS OF AUTO & MANUAL GIMBAL CONTROL AND BEAM WIDTH SWITCHING
S-BAND PWR AMPL/PHASE MOD XPNDR 2 GROUP 2 CB20
(0.79A)
USB SEC PM XMTR & RCVR LOSS OF REDUNDANT PM XMTR & RCVR
(1.14A-LO) (3.29A-HI)
SEC S-BAND PWR AMPL LOSS OF REDUNDANT POWER AMPL
RHEB-226
FUEL CELL PUMPS 1 (S1-MDC 5) AC1 AC2
FUEL CELL 1 PUMPS AC
(3.1A) (3.8A-SL)
POWER FACTOR CORR BOX LOSS OF GLYCOL PUMP, H2 PUMP, AND PH SNSR (ΦA), PUMPS WORK WITH 2 OF 3 PHASES
FUEL CELL PUMPS 2 (S2-MDC 5 AC1 AC2
FUEL CELL 2 PUMPS AC
(3.1A) (3.8A-SL)
POWER FACTOR CORR BOX LOSS OF GLYCOL PUMP, H2 PUMP, AND PH SNSR (ΦA), PUMPS WORK WITH 2 OF 3 PHASES
FUEL CELL PUMPS 3 (S3-MDC 5) AC1 AC2
FUEL CELL 3 PUMPS AC
(3.1A) (3.8A-SL)
POWER FACTOR CORR BOX LOSS OF GLYCOL PUMP, H2 PUMP, AND PH SNSR (ΦA), PUMPS WORK WITH 2 OF 3 PHASES
CRYOGENIC QTY AMPL 1 AC 1 CB20
(0.32A)
O2 TANK 1 AND H2 TANK 1 QTY SIGNAL CONDITIONERS LOSS OF ONBOARD AND TM H2 AND O2 TANK 1 QTYS
CRYOGENIC FAN MOTORS TANK 1 AC 1 ΦA CB22
CRYOGENIC FAN MOTORS TANK 1 AC 1 ΦB CB23
CRYOGENIC FAN MOTORS TANK 1 AC 1 ΦC CB24
(0.33A)
H2 TANK 1 FANS SW (S17-MDC 2) LOSS OF FANS, WORKS WITH 2 OF 3 PHASES
(2.52A)
O2 TANK 1 FANS SW (S19-MDC 2) LOSS OF FANS WORKS WITH 2 OF 3 PHASES
LIGHTING NUMERICS INTEGRAL RMDC-AC1 CB34
(0.82A)
NUMERICS LT SW (T2-MDC 5) LOSS OF NUMERICS LIGHTING ON MDC-2,3,4,5, & 6 AND RHEB-229 & 275
LIGHTING NUMERICS INTEGRAL LMDC-AC1 CB37
(0.41A)
NUMERICS LT SW (T2 & T3 - MDC 8) LOSS OF NUMERICS LIGHTING ON MDC-1,2,7,8, & 9 AND THE EMS DISPLAY
LIGHTING RUN/EVA/TRGT AC1 CB40
(0.66A)
EXTERIOR LIGHTS SW (S5-MDC 2) LOSS OF HALF OF LIGHTS OUT OF EACH GROUP
VAC2 AC BUS 2



NOTES:
1. ALL CURRENT RATINGS ARE DC EQUIVALENT

APP [signature] 12/14/67
ENG C. M. Jones 12/13/67

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
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POWER DISTRIBUTION MATRIX AC BUSES

CSM 104	DWG NO FIGURE 3.3
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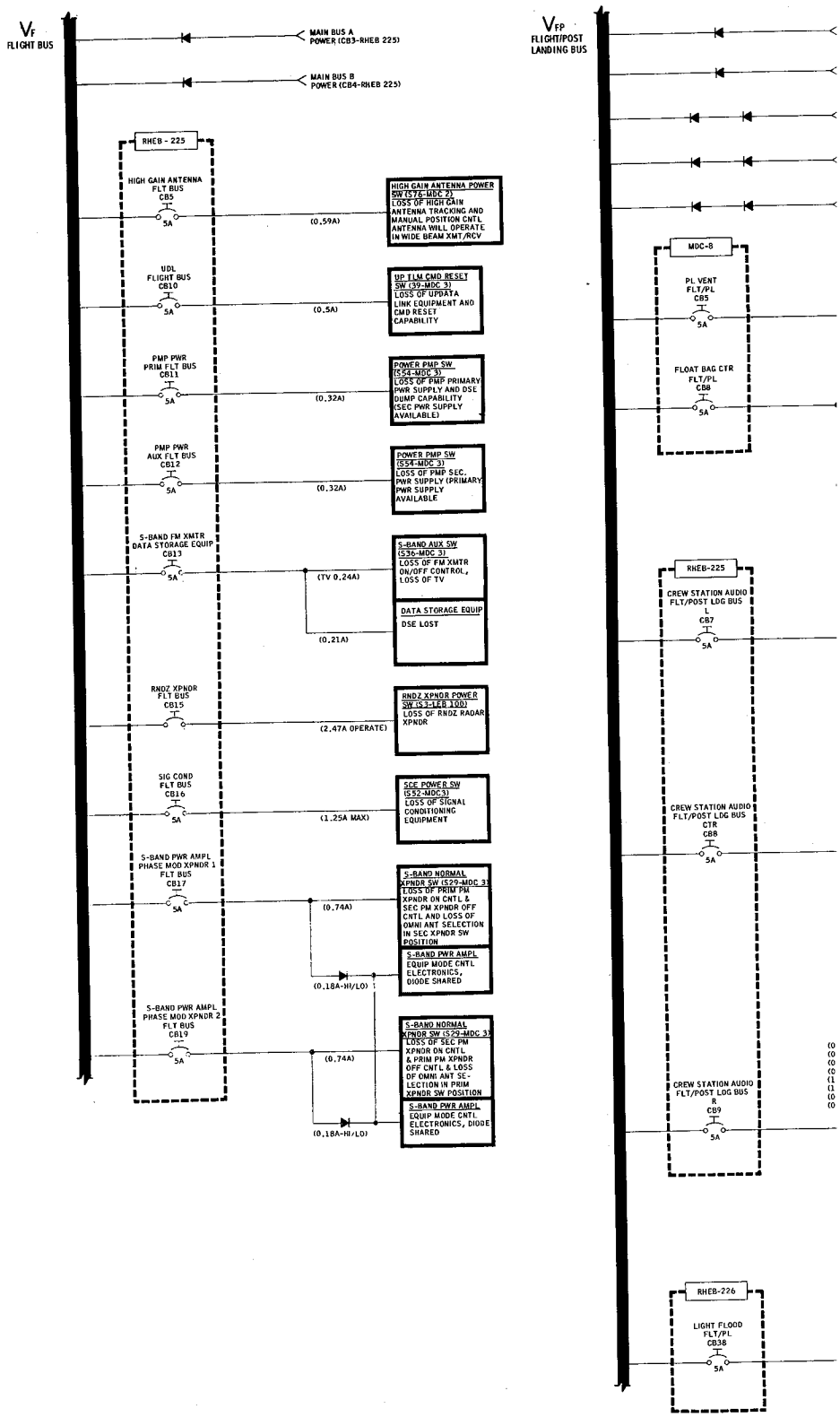
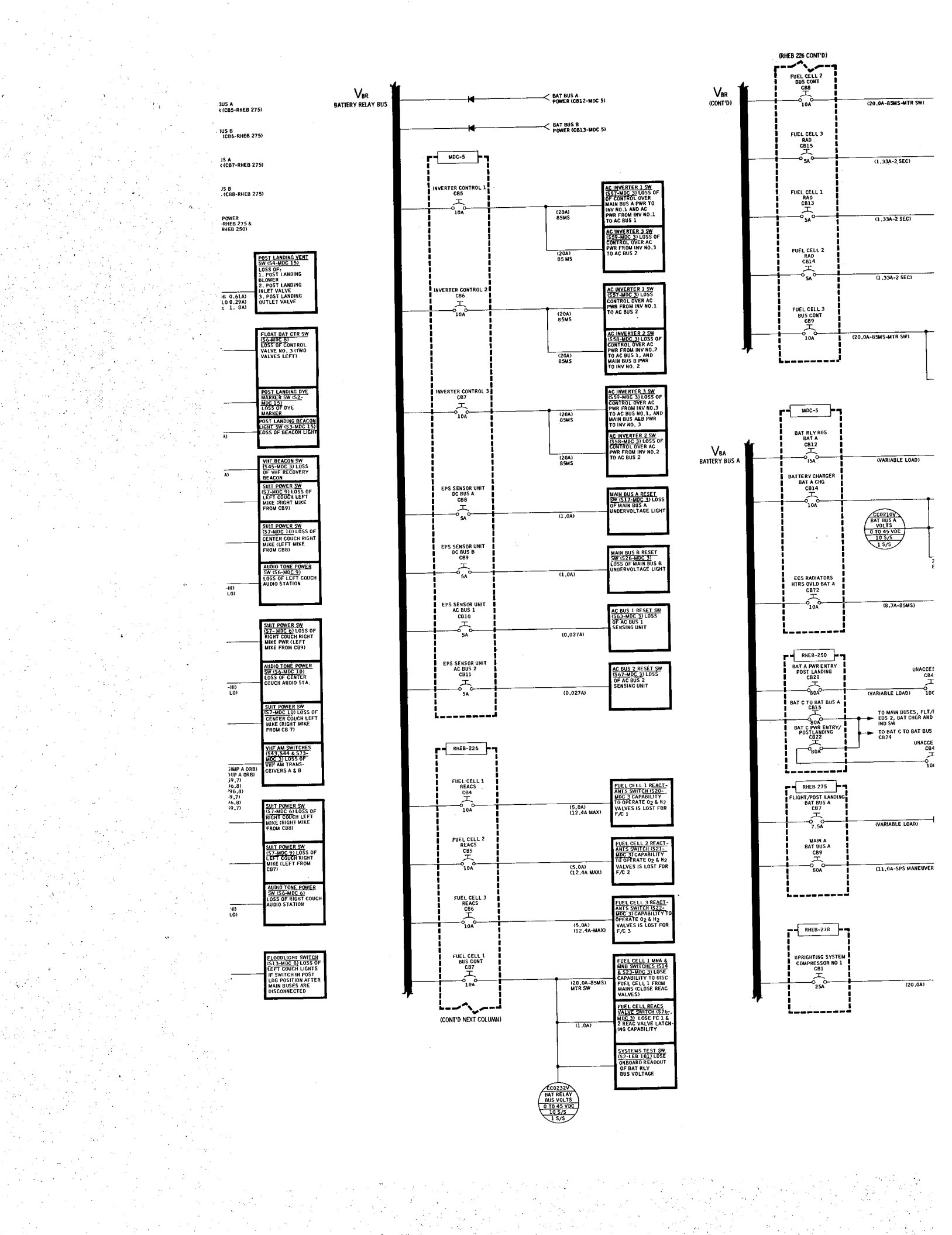
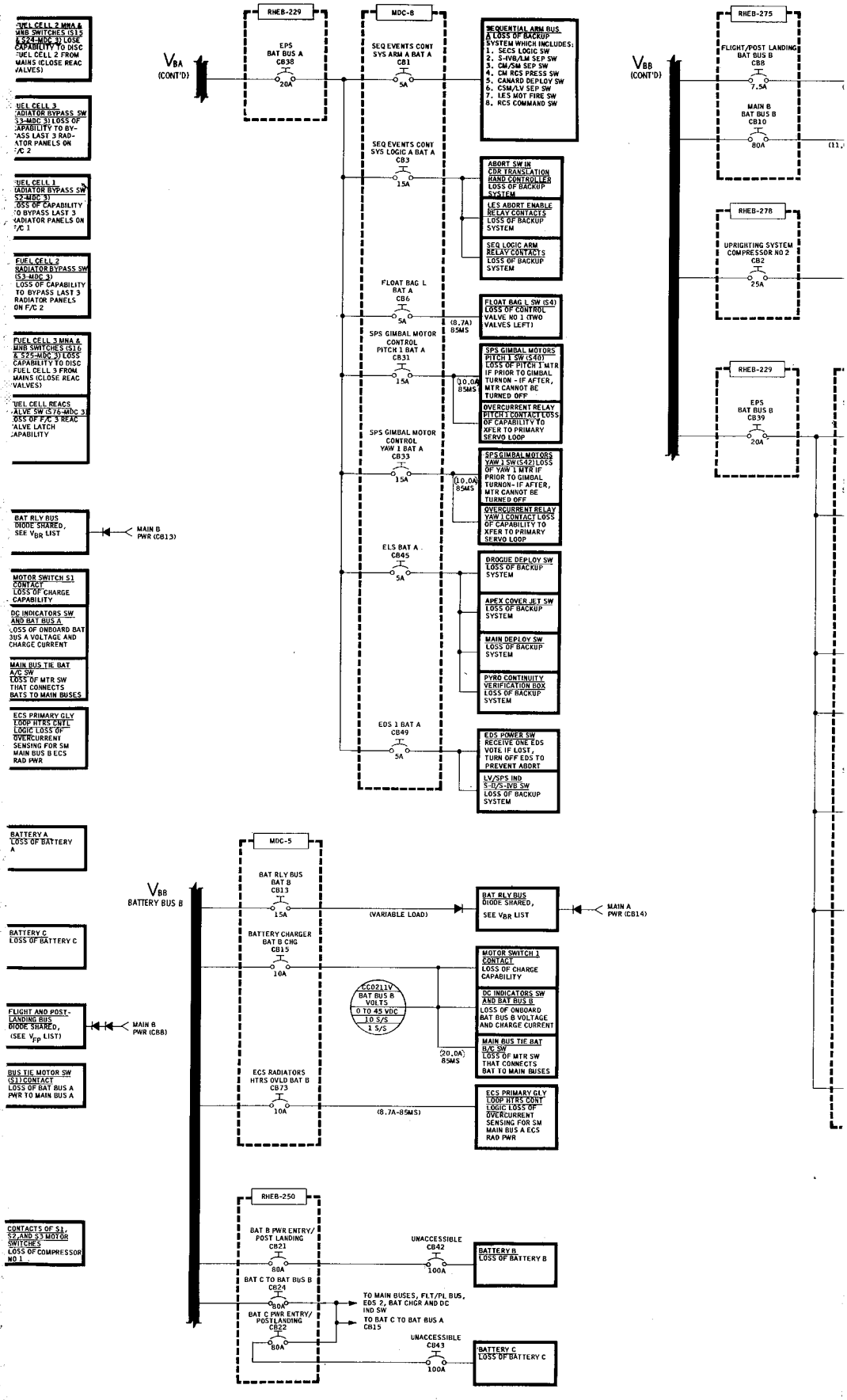
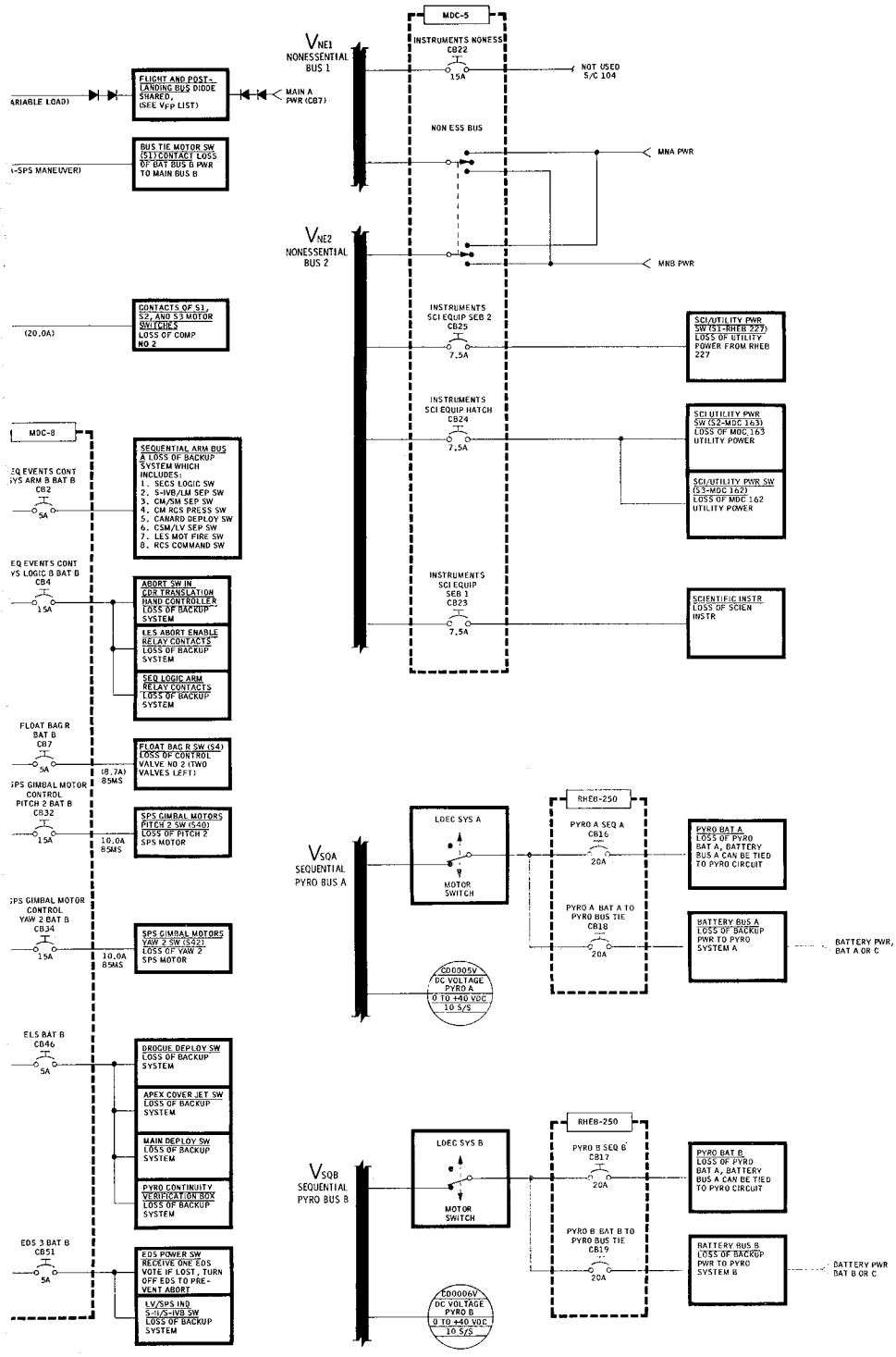

V_F
FLIGHT BUS
MAIN BUS A
POWER (CB3-RHEB 225)
MAIN BUS B
POWER (CB4-RHEB 225)
RHEB - 225
HIGH GAIN ANTENNA
FLT BUS
CB5
5A
(0.59A)
HIGH GAIN ANTENNA POWER SW (S76-MDC 2)
LOSS OF HIGH GAIN ANTENNA TRACKING AND MANUAL POSITION CNTL ANTENNA WILL OPERATE IN WIDE BEAM XMT/RCV
UDL
FLIGHT BUS
CB10
5A
(0.5A)
UP FLM CMD RESET SW (S9-MDC 3)
LOSS OF UPDATA LINK EQUIPMENT AND CMD RESET CAPABILITY
PMP PWR
PRIM FLT BUS
CB11
5A
(0.32A)
POWER PMP SW (S54-MDC 3)
LOSS OF PMP PRIMARY PWR SUPPLY AND DSE DUMP CAPABILITY (SEC PWR SUPPLY AVAILABLE)
PMP PWR
AUX FLT BUS
CB12
5A
(0.32A)
POWER PMP SW (S54-MDC 3)
LOSS OF PMP SEC. PWR SUPPLY (PRIMARY PWR SUPPLY AVAILABLE
S-BAND FM XMTR
DATA STORAGE EQUIP
CB13
5A
(TV 0.24A)
S-BAND AUX SW (S36-MDC 3)
LOSS OF FM XMTR ON/OFF CONTROL, LOSS OF TV
(0.21A)
DATA STORAGE EQUIP
DSE LOST
RNDZ XPNDR
FLT BUS
CB15
(2.47A OPERATE)
RNDZ XPNDR POWER SW (S3-LEB 108)
LOSS OF RNDZ RADAR XPNDR
SIG COND
FLT BUS
CB16
5A
(1.25A MAX)
SCE POWER SW (S52-MDC 3)
LOSS OF SIGNAL CONDITIONING EQUIPMENT
S-BAND PWR AMPL
PHASE MOD XPNDR 1
FLT BUS
CB17
5A
(0.74A)
S-BAND NORMAL XPNDR SW (S29-MDC 3)
LOSS OF PRIM PM XPNDR ON CNTL & SEC PM XPNDR OFF CNTL AND LOSS OF OMNI ANT SELECTION IN SEC XPNDR SW POSITION
(0.18A-HI/LO)
S-BAND PWR AMPL
EQUIP MODE CNTL ELECTRONICS, DIODE SHARED
S-BAND PWR AMPL
PHASE MOD XPNDR 2
FLT BUS
CB19
5A
(0.74A)
S-BAND NORMAL XPNDR SW (S29-MDC 3)
LOSS OF SEC PM XPNDR ON CNTL & PRIM PM XPNDR OFF CNTL & LOSS OF OMNI ANT SELECTION IN PRIM XPNDR SW POSITION
(0.18A-HI/LO)
S-BAND PWR AMPL
EQUIP MODE CNTL ELECTRONICS, DIODE SHARED
V_{FP}
FLIGHT/POST
LANDING BUS
MDC-8
PL VENT
FLT/PL
CB5
5A
FLOAT BAG CTR
FLT/PL
CB8
5A
RHEB-225
CREW STATION AUDIO
FLT/POST LDG BUS
L
CB7
5A
CREW STATION AUDIO
FLT/POST LDG BUS
CTR
CB8
5A
CREW STATION AUDIO
FLT/POST LDG BUS
R
CB9
5A
RHEB-226
LIGHT FLOOD
FLT/PL
CB38
5A


(RHEB 226 CONT'D)
VBR (CONT'D)
FUEL CELL 2 BUS CONT CB8
10A
(20.0A-85MS-MTR SW)
FUEL CELL 3 RAD CB15
5A
(1.33A-2 SEC)
FUEL CELL 1 RAD CB13
5A
(1.33A-2 SEC)
FUEL CELL 2 RAD CB14
5A
(1.33A-2 SEC)
FUEL CELL 3 BUS CONT CB9
10A
(20.0A-85MS-MTR SW)
VBR BATTERY RELAY BUS
BAT BUS A POWER (CB12-MDC 5)
BAT BUS B POWER (CB13-MDC 5)
MDC-5
INVERTER CONTROL 1 CB5
10A
(20A) 85MS
(20A) 85 MS
AC INVERTER 1 SW (S57-MDC 3) LOSS OF OF CONTROL OVER MAIN BUS A PWR TO INV NO.1 AND AC PWR FROM INV NO.1 TO AC BUS 1
AC INVERTER 3 SW (S59-MDC 3) LOSS OF CONTROL OVER AC PWR FROM INV NO.3 TO AC BUS 2
INVERTER CONTROL 2 CB6
10A
(20A) 85MS
(20A) 85MS
AC INVERTER 1 SW (S57-MDC 3) LOSS CONTROL OVER AC PWR FROM INV NO.1 TO AC BUS 2
AC INVERTER 2 SW (S58-MDC 3) LOSS OF CONTROL OVER AC PWR FROM INV NO.2 TO AC BUS 1, AND MAIN BUS B PWR TO INV NO. 2
INVERTER CONTROL 3 CB7
10A
(20A) 85MS
(20A) 85MS
AC INVERTER 3 SW (S59-MDC 3) LOSS OF CONTROL OVER AC PWR FROM INV NO.3 TO AC BUS NO.1, AND MAIN BUS A&B PWR TO INV NO. 3
AC INVERTER 2 SW (S58-MDC 3) LOSS OF CONTROL OVER AC PWR FROM INV NO.2 TO AC BUS 2
EPS SENSOR UNIT DC BUS A CB8
5A
(1.0A)
MAIN BUS A RESET SW (S17-MDC 3) LOSS OF MAIN BUS A UNDERVOLTAGE LIGHT
EPS SENSOR UNIT DC BUS B CB9
5A
(1.0A)
MAIN BUS B RESET SW (S26-MDC 3) LOSS OF MAIN BUS B UNDERVOLTAGE LIGHT
EPS SENSOR UNIT AC BUS 1 CB10
5A
(0.027A)
AC BUS 1 RESET SW (S63-MDC 3) LOSS OF AC BUS 1 SENSING UNIT
EPS SENSOR UNIT AC BUS 2 CB11
5A
(0.027A)
AC BUS 2 RESET SW (S67-MDC 3) LOSS OF AC BUS 2 SENSING UNIT
RHEB-226
FUEL CELL 1 REACS CB4
10A
(5.0A) (12.4A MAX)
FUEL CELL 1 REACTANTS SWITCH (S20-MDC 3 CAPABILITY TO OPERATE O2 & H2 VALVES IS LOST FOR F/C 1
FUEL CELL 2 REACS CB5
10A
(5.0A) (12.4A MAX)
FUEL CELL 2 REACTANTS SWITCH (S21-MDC 3) CAPABILITY TO OPERATE O2 & H2 VALVES IS LOST FOR F/C 2
FUEL CELL 3 REACS CB6
10A
(5.0A) (12.4A MAX)
FUEL CELL 3 REACTANTS SWITCH (S22-MDC 3) CAPABILITY TO OPERATE O2 & H2 VALVES IS LOST FOR F/C 3
FUEL CELL 1 BUS CONT CB7
10A
(20.0A-85MS) MTR SW
FUEL CELL 1 MNA & MNB SWITCHES (S14 & S22-MDC 3) LOSE CAPABILITY TO DISC FUEL CELL 1 FROM MAINS (CLOSE REAC VALVES)
(1.0A)
FUEL CELL REACS VALVE SWITCH (S76-MDC 3) LOSE FC 1 & 2 REAC VALVE LATCHING CAPABILITY
SYSTEMS TEST SW (S2-1EE 10) LOSE ONBOARD READOUT OF BAT RLY BUS VOLTAGE
CC0232V BAT RELAY BUS VOLTS 0 TO 45 VDC 10 S/S 1 S/S
(CONT'D NEXT COLUMN)
VBA BATTERY BUS A
MDC-5
BAT RLY BUS BAT A CB12
15A
(VARIABLE LOAD)
BATTERY CHARGER BAT A CHG CB14
10A
CC0210V BAT BUS A VOLTS 0 TO 45 VDC 10 S/S 1 S/S
ECS RADIATORS HTRS OVLD BAT A CB72
10A
(8.7A-85MS)
RHEB-250
BAT A PWR ENTRY POST LANDING CB20
80A
(VARIABLE LOAD)
BAT C TO BAT BUS A CB15
80A
BAT C PWR ENTRY/ POST LANDING CB22
80A
TO MAIN BUSES, FLT/
EDS 2, BAT CHGR AND IND SW
TO BAT C TO BAT BUS CB24
RHEB 275
FLIGHT/POST LANDING BAT BUS A CB7
7.5A
(VARIABLE LOAD)
MAIN A BAT BUS A CB9
80A
(11.0A-SPS MANEUVER
RHEB-278
UPRIGHTING SYSTEM COMPRESSOR NO 1 CB1
25A
(20.0A)
POST LANDING VENT SW (S4-MDC 15) LOSS OF: 1. POST LANDING BLOWER 2. POST LANDING INLET VALVE 3. POST LANDING OUTLET VALVE
FLOAT BAT CTR SW (S6-MDC 8) LOSS OF CONTROL VALVE NO. 3 (TWO VALVES LEFT)
POST LANDING DYE MARKER SW (S2-MDC 15) LOSS OF DYE MARKER
POST LANDING BEACON LIGHT SW (S3-MDC 15) LOSS OF BEACON LIGHT
VHF BEACON SW (S45-MDC 3) LOSS OF VHF RECOVERY BEACON
SUIT POWER SW (S7-MDC 9) LOSS OF LEFT COUCH LEFT MIKE (RIGHT MIKE FROM CB9)
SUIT POWER SW (S7-MDC 10) LOSS OF CENTER COUCH RIGHT MIKE (LEFT MIKE FROM CB8)
AUDIO TONE POWER SW (S6-MDC 9) LOSS OF LEFT COUCH AUDIO STATION
SUIT POWER SW (S7-MDC 6) LOSS OF RIGHT COUCH RIGHT MIKE PWR (LEFT MIKE FROM CB9)
AUDIO TONE POWER SW (S6-MDC 10) LOSS OF CENTER COUCH AUDIO STA.
SUIT POWER SW (S7-MDC 10) LOSS OF CENTER COUCH LEFT MIKE (RIGHT MIKE FROM CB 7)
VHF AM SWITCHES (S43, S44 & S73-MDC 3) LOSS OF VHF AM TRANSCEIVERS A & B
SUIT POWER SW (S7-MDC 6) LOSS OF RIGHT COUCH LEFT MIKE (RIGHT MIKE FROM CB8)
SUIT POWER SW (S7-MDC 9) LOSS OF LEFT COUCH RIGHT MIKE (LEFT FROM CB7)
AUDIO TONE POWER SW (S6-MDC 6) LOSS OF RIGHT COUCH AUDIO STATION
FLOODLIGHT SWITCH (S13-MDC 8) LOSS OF LEFT COUCH LIGHTS IF SWITCH IN POST LDG POSITION AFTER MAIN BUSES ARE DISCONNECTED


RHEB-229
EPS BAT BUS A CB38 20A
MDC-8
SEQ EVENTS CONT SYS ARM A BAT A CB1 5A
SEQUENTIAL ARM BUS A LOSS OF BACKUP SYSTEM WHICH INCLUDES: 1. SECS LOGIC SW 2. S-IVB/LM SEP SW 3. CM/SM SEP SW 4. CM RCS PRESS SW 5. CANARD DEPLOY SW 6. CSM/LV SEP SW 7. LES MOT FIRE SW 8. RCS COMMAND SW
SEQ EVENTS CONT SYS LOGIC A BAT A CB3 15A
ABORT SW IN CDR TRANSLATION HAND CONTROLLER LOSS OF BACKUP SYSTEM
LES ABORT ENABLE RELAY CONTACTS LOSS OF BACKUP SYSTEM
SEQ LOGIC ARM RELAY CONTACTS LOSS OF BACKUP SYSTEM
FLOAT BAG L BAT A CB6 5A
FLOAT BAG L SW (S4) LOSS OF CONTROL VALVE NO 1 (TWO VALVES LEFT)
(8.7A) 85MS
SPS GIMBAL MOTOR CONTROL PITCH 1 BAT A CB31 15A
SPS GIMBAL MOTORS PITCH 1 SW (S40) LOSS OF PITCH 1 MTR IF PRIOR TO GIMBAL TURNON - IF AFTER, MTR CANNOT BE TURNED OFF
OVERCURRENT RELAY PITCH 1 CONTACT LOSS OF CAPABILITY TO XFER TO PRIMARY SERVO LOOP
(10.0A) 85MS
SPS GIMBAL MOTOR CONTROL YAW 1 BAT A CB33 15A
SPS GIMBAL MOTORS YAW 1 SW (S42) LOSS OF YAW 1 MTR IF PRIOR TO GIMBAL TURNON - IF AFTER, MTR CANNOT BE TURNED OFF
OVERCURRENT RELAY YAW 1 CONTACT LOSS OF CAPABILITY TO XFER TO PRIMARY SERVO LOOP
(10.0A) 85MS
ELS BAT A CB45 5A
DROGUE DEPLOY SW LOSS OF BACKUP SYSTEM
APEX COVER JET SW LOSS OF BACKUP SYSTEM
MAIN DEPLOY SW LOSS OF BACKUP SYSTEM
PYRO CONTINUITY VERIFICATION BOX LOSS OF BACKUP SYSTEM
EDS 1 BAT A CB49 5A
EDS POWER SW RECEIVE ONE EDS VOTE IF LOST, TURN OFF EDS TO PREVENT ABORT
LV/SPS IND S-IVB/IVB SW LOSS OF BACKUP SYSTEM
V_{BA} (CONT'D)
FUEL CELL 2 MNA & MNB SWITCHES (S15 & S24-MDC 3) LOSE CAPABILITY TO DISC FUEL CELL 2 FROM MAINS (CLOSE REAC VALVES)
FUEL CELL 3 RADIATOR BYPASS SW S3-MDC 3) LOSS OF CAPABILITY TO BYPASS LAST 3 RADIATOR PANELS ON F/C 2
FUEL CELL 1 RADIATOR BYPASS SW S2-MDC 3) LOSS OF CAPABILITY TO BYPASS LAST 3 RADIATOR PANELS ON F/C 1
FUEL CELL 2 RADIATOR BYPASS SW (S3-MDC 3) LOSS OF CAPABILITY TO BYPASS LAST 3 RADIATOR PANELS ON F/C 2
FUEL CELL 3 MNA & MNB SWITCHES (S16 & S25-MDC 3) LOSS CAPABILITY TO DISC FUEL CELL 3 FROM MAINS (CLOSE REAC VALVES)
FUEL CELL REACS VALVE SW (S76-MDC 3) LOSS OF F/C 3 REAC VALVE LATCH CAPABILITY
BAT RLY BUS DIODE SHARED, SEE V_{BR} LIST
MAIN B PWR (CB13)
MOTOR SWITCH S1 CONTACT LOSS OF CHARGE CAPABILITY
DC INDICATORS SW AND BAT BUS A LOSS OF ONBOARD BAT BUS A VOLTAGE AND CHARGE CURRENT
MAIN BUS TIE BAT A/C SW LOSS OF MTR SW THAT CONNECTS BATS TO MAIN BUSES
ECS PRIMARY GLY LOOP HTRS CNTL LOGIC LOSS OF OVERCURRENT SENSING FOR SM MAIN BUS B ECS RAD PWR
RHEB-275
FLIGHT/POST LANDING BAT BUS B CB8 7.5A
MAIN B BAT BUS B CB10 80A
RHEB-278
UPRIGHTING SYSTEM COMPRESSOR NO 2 CB2 25A
RHEB-229
EPS BAT BUS B CB39 20A
V_{BB} (CONT'D)
BATTERY A LOSS OF BATTERY A
MDC-5
BAT RLY BUS BAT B CB13 15A
(VARIABLE LOAD)
BAT RLY BUS DIODE SHARED, SEE V_{BR} LIST
MAIN A PWR (CB14)
V_{BB} BATTERY BUS B
BATTERY CHARGER BAT B CHG CB15 10A
BATTERY C LOSS OF BATTERY C
MOTOR SWITCH 1 CONTACT LOSS OF CHARGE CAPABILITY
DC INDICATORS SW AND BAT BUS B LOSS OF ONBOARD BAT BUS B VOLTAGE AND CHARGE CURRENT
(CD0211V) BAT BUS B VOLTS 0 TO 45 VDC 10 S/S 1 S/S
MAIN BUS TIE BAT B/C SW LOSS OF MTR SW THAT CONNECTS BAT TO MAIN BUSES
(20.0A) 85MS
FLIGHT AND POST-LANDING BUS DIODE SHARED, (SEE V_{FP} LIST)
MAIN B PWR (CB8)
BUS TIE MOTOR SW (S1) CONTACT LOSS OF BAT BUS A PWR TO MAIN BUS A
ECS RADIATORS HTRS OVLD BAT B CB73 10A
(8.7A-85MS)
ECS PRIMARY GLY LOOP HTRS CONT LOGIC LOSS OF OVERCURRENT SENSING FOR SM MAIN BUS A ECS RAD PWR
RHEB-250
BAT B PWR ENTRY/ POST LANDING CB21 80A
UNACCESSIBLE CB42 100A
BATTERY B LOSS OF BATTERY B
BAT C TO BAT BUS B CB24 80A
TO MAIN BUSES, FLT/PL BUS, EDS 2, BAT CHGR AND DC IND SW
TO BAT C TO BAT BUS A CB15
BAT C PWR ENTRY/ POST LANDING CB22 80A
UNACCESSIBLE CB43 100A
BATTERY C LOSS OF BATTERY C
CONTACTS OF S1, S2, AND S3 MOTOR SWITCHES LOSS OF COMPRESSOR NO 1



APP
ENG C.M. Jones 12/3/68

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
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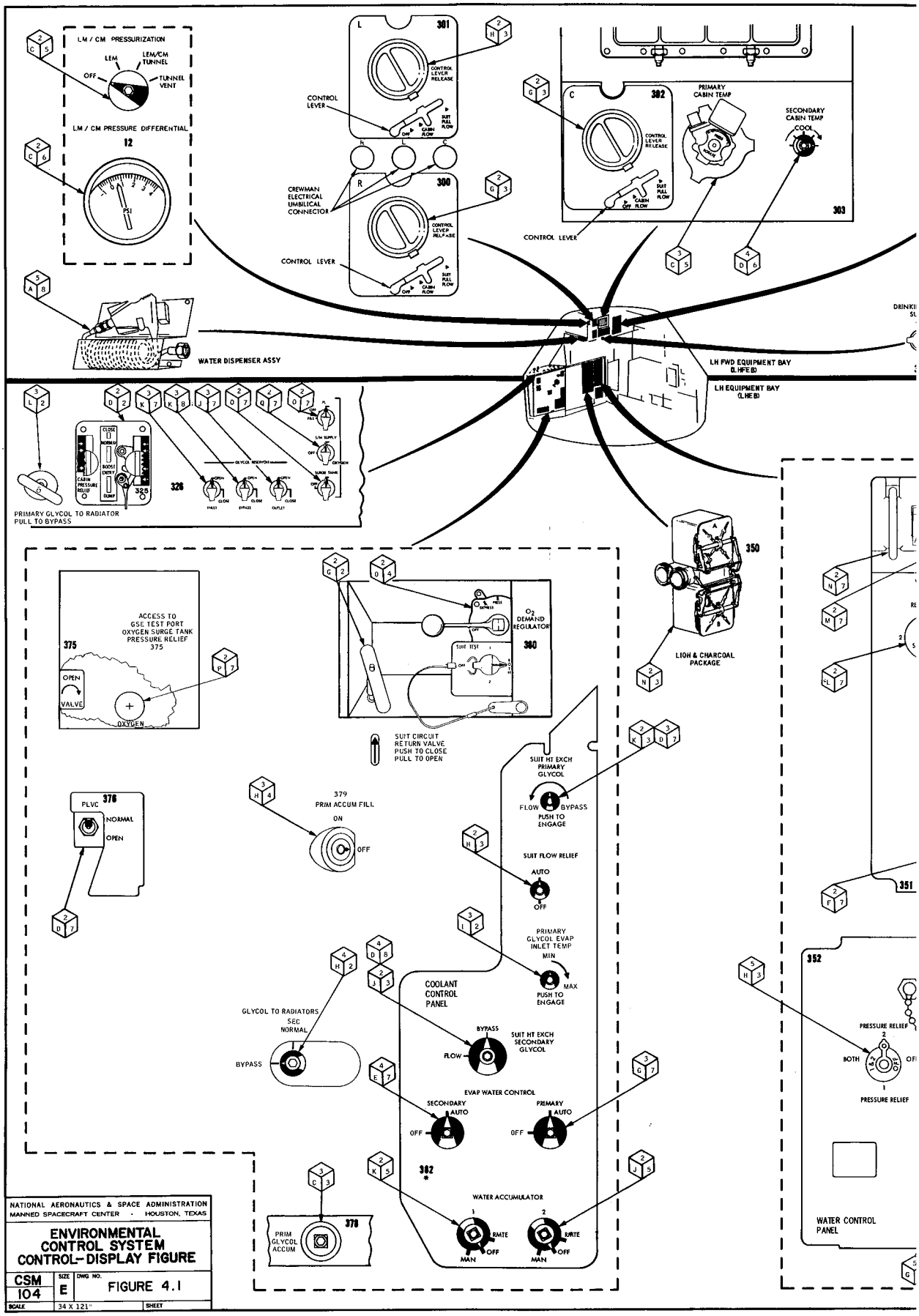
POWER DISTRIBUTION MATRIX MISCELLANEOUS BUSES

CSM 104	DWG NO FIGURE 3.4
	PAGE SHEET OF

CORRECTIONS TO FIGURE 3.4, POWER DISTRIBUTION MATRIX, MISCELLANEOUS BUSES

$V_{(MISC. BUSES)}$	RHEB	MDC	CHANGE
V_{BR}		MDC-5	
		CB8	SHOULD READ: MAIN BUS A RESET SW (S17-MDC 3) LOSS OF MAIN BUS A UNDERVOLTAGE LIGHT IF SW S17-MDC 2 IS IN THE ACK POSITION
		CB9	SHOULD READ: MAIN BUS B RESET SW (S26-MDC 3) LOSS OF MAIN BUS B UNDERVOLTAGE LIGHT IF SW S17-MDC 2 IS IN THE ACK POSITION
V_{BA}		MDC-5	
		CB12	THE SHARED POWER INPUT SHOULD BE FROM V_{BB}, NOT MAIN B.
V_{BB}		CB13	THE SHARED POWER INPUT SHOULD BE FROM V_{BA}, CB12, NOT MAIN A CB14
V_{NE2}		MDC-5	
		CB25	CORRECT CB TITLE TO READ: INSTRUMENTS SCI EQUIP HATCH
		CB24	CORRECT CB TITLE TO READ: INSTRUMENTS SCI EQUIP SEB 2
V_{SQA}			TM - CORRECT THE TM NOMENCLATURE TO READ: PYRO BUS A VOLTS
			ADD RHEB 229 MAIN RELEASE CB48, 5 AMP, WHICH SHOULD READ AS FOLLOWS: MAIN CHUTE DISC RELAY LOSS OF SYS A
V_{SQB}	RHEB 250 CB17		SHOULD READ: PYRO BAT B LOSS OF PYRO BAT B, BATTERY BUS A CAN BE RETIED TO PYRO CIRCUIT
			TM - CORRECT THE TM NOMENCLATURE TO READ: PYRO BUS B VOLTS
			ADD RHEB 229 MAIN RELEASE CB49, 7.5 AMP, WHICH SHOULD READ AS FOLLOWS: MAIN CHUTE DISC RELAY LOSS OF SYS B

4 ENVIRONMENTA
CONTROL SYS



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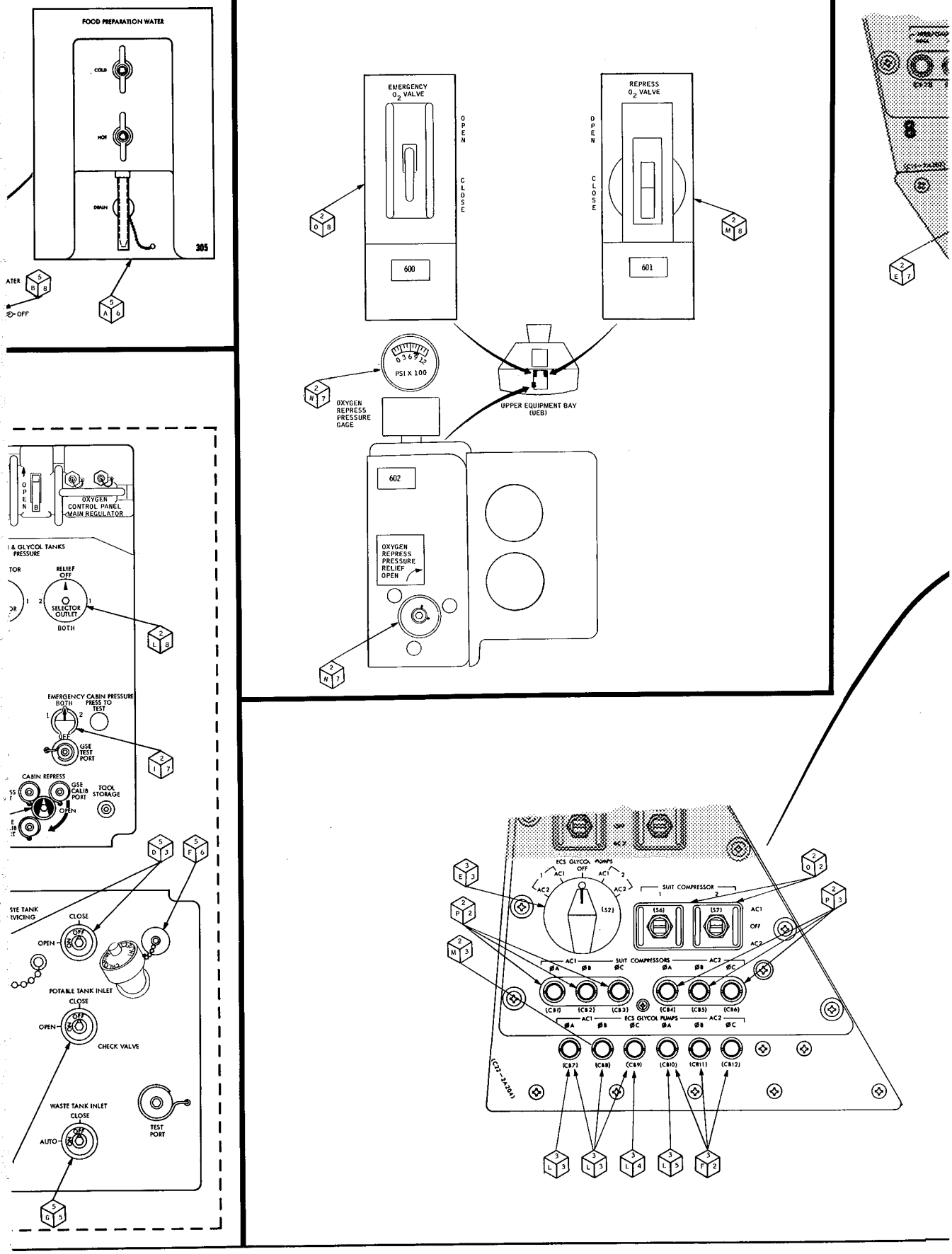
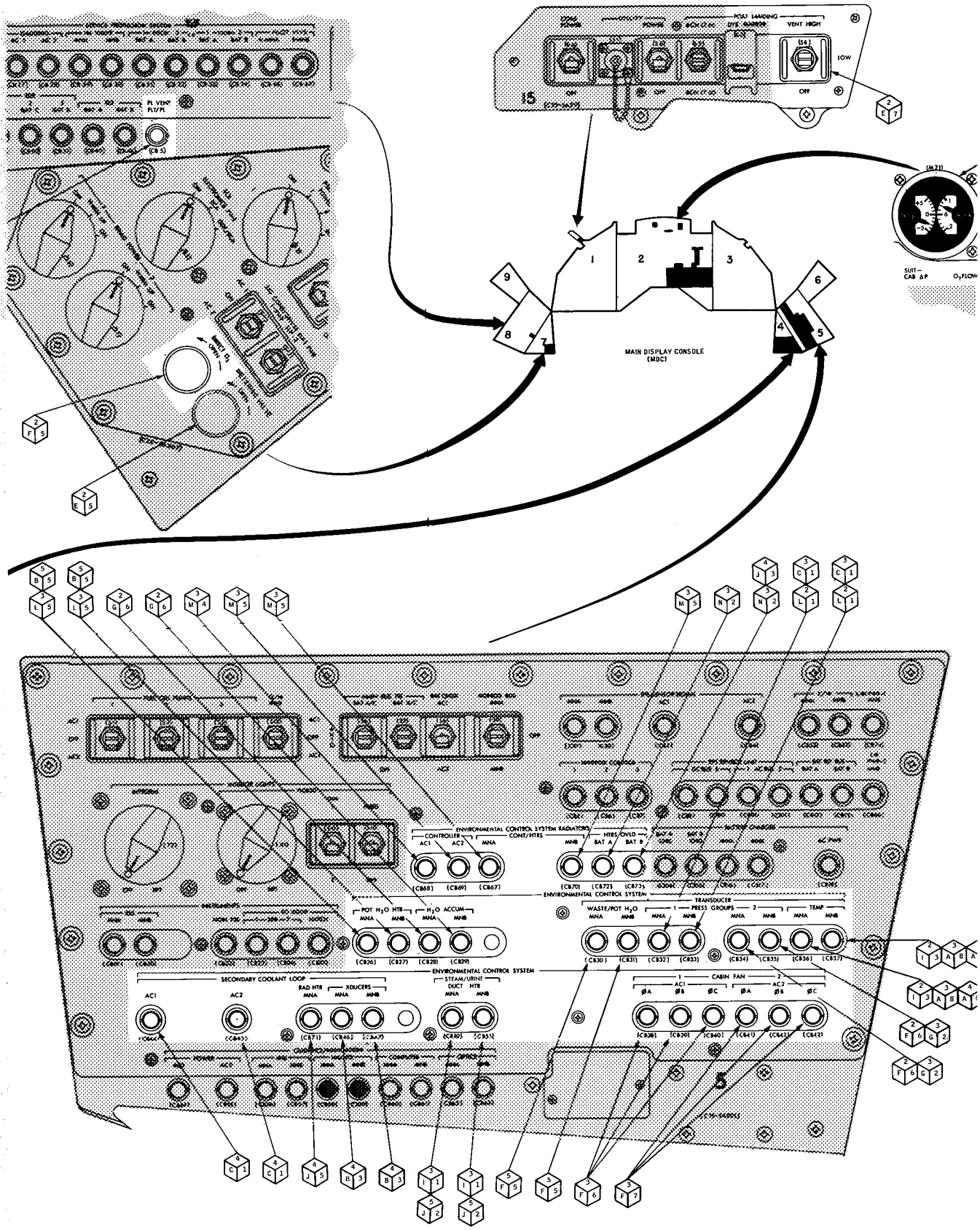
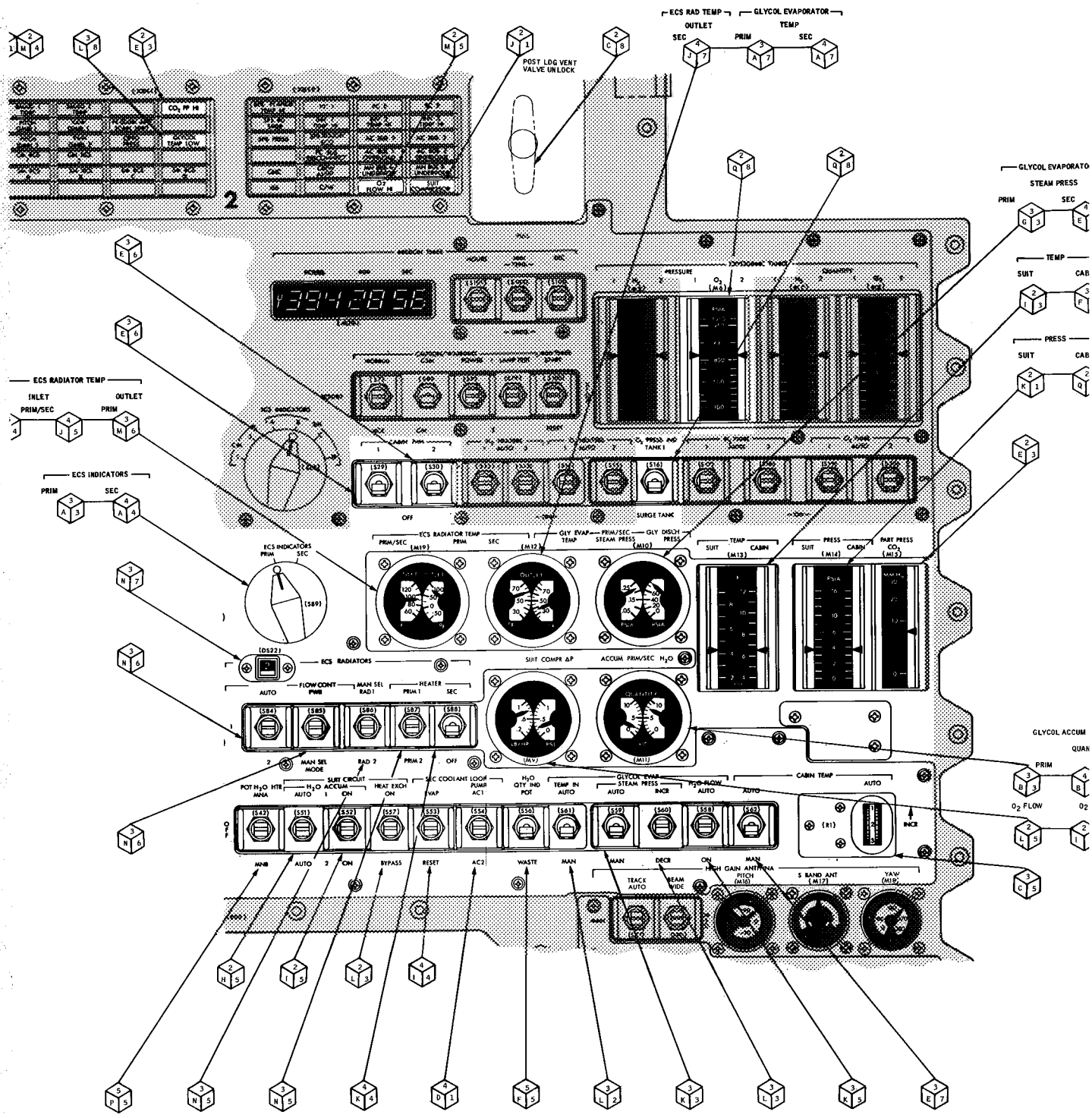
ENVIRONMENTAL CONTROL SYSTEM CONTROL-DISPLAY FIGURE

CSM 104	SIZE E	DWG NO. FIGURE 4.1
SCALE	34 X 121"	SHEET


FOOD PREPARATION WATER
COLD
HOT
DRAIN
305
OFF
EMERGENCY O_2 VALVE
OPEN
CLOSE
600
REPRESS O_2 VALVE
601
PSI X 100
OXYGEN REPRESS PRESSURE GAGE
UPPER EQUIPMENT BAY (UEB)
602
OXYGEN REPRESS PRESSURE RELIEF OPEN
OXYGEN CONTROL PANEL MAIN REGULATOR
& GLYCOL TANKS PRESSURE
RELIEF OFF
SELECTOR OUTLET
BOTH
EMERGENCY CABIN PRESSURE
BOTH
PRESS TO TEST
OFF
GSE TEST PORT
CABIN REPRESS
GSE CALIB PORT
TOOL STORAGE
OPEN
STE TANK SERVICING
CLOSE
OPEN
POTABLE TANK INLET
CHECK VALVE
WASTE TANK INLET
AUTO
TEST PORT
ECS GLYCOL PUMPS
SUIT COMPRESSOR
SUIT COMPRESSORS
(S2)
(S6)
(S7)
(CB1)
(CB2)
(CB3)
(CB4)
(CB5)
(CB6)
(CB7)
(CB8)
(CB9)
(CB10)
(CB11)
(CB12)
(C22-2A2041)


MAIN DISPLAY CONSOLE
(MDC)
ENVIRONMENTAL CONTROL SYSTEM
ENVIRONMENTAL CONTROL SYSTEM RADIATORS CONT/HTRS
SECONDARY COOLANT LOOP
TRANSDUCER
CABIN FAN


ECS RAD TEMP
OUTLET
SEC
PRIM
GLYCOL EVAPORATOR
TEMP
SEC
POST LOG VENT VALVE UNLOCK
GLYCOL EVAPORATO
STEAM PRESS
PRIM
SEC
TEMP
SUIT
CAB
PRESS
SUIT
CAB
ECS RADIATOR TEMP
INLET
PRIM/SEC
OUTLET
PRIM
ECS INDICATORS
PRIM
SEC
ECS INDICATORS
PRIM
SEC
(S89)
(DS22)
ECS RADIATORS
AUTO
FLOW CONT
PWR
MAN SEL
RAD 1
HEATER
PRIM 1
SEC
(S84)
(S85)
(S86)
(S87)
(S88)
2
MAN SEL MODE
RAD 2
PRIM 2
OFF
ECS RADIATOR TEMP
PRIM/SEC
PRIM
SEC
(M19)
(M12)
GLY EVAP TEMP
GLY EVAP
STEAM PRESS
PRIM/SEC
GLY DISCH PRESS
(M10)
SUIT COMPR ΔP
ACCUM PRIM/SEC H2O
TEMP
SUIT
CABIN
(M13)
PRESS
SUIT
CABIN
(M14)
PART PRESS CO2
(M15)
SURGE TANK
(S29)
(S30)
(S16)
OFF
GLYCOL ACCUM
QUAN
PRIM
O2 FLOW
O2
CABIN TEMP
AUTO
AUTO
(R1)
INCR
POT H2O HTR
MANA
H2O ACCUM
AUTO
SUIT CIRCUIT
1
ON
HEAT EXCH
ON
SEC COOLANT LOOP
VAP
PUMP
AC1
H2O QTY IND
POT
TEMP IN
AUTO
GLYCOL EVAP
STEAM PRESS
AUTO
INCR
H2O FLOW
AUTO
AUTO
AUTO
(S42)
(S51)
(S52)
(S57)
(S53)
(S54)
(S56)
(S61)
(S59)
(S60)
(S58)
(S62)
MNB
AUTO
2
ON
BYPASS
RESET
AC2
WASTE
MAN
MAN
DECR
ON
HIGH GAIN ANTENNA
MAN
TRACK
AUTO
BEAM
WIDE
PITCH
(M16)
S BAND ANT
(M17)
YAW
(M18)

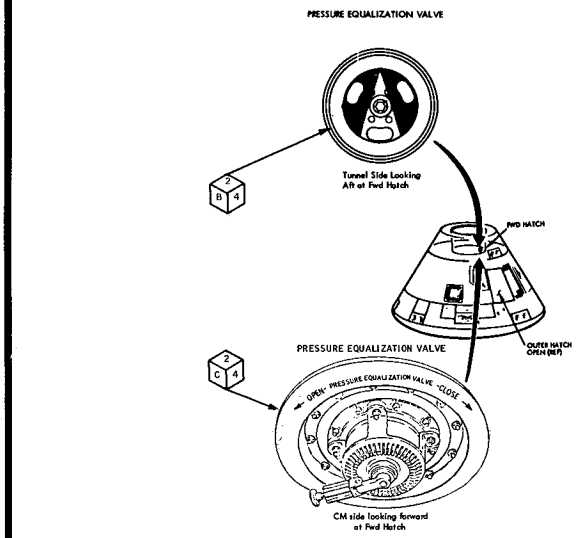
GLY DISCH

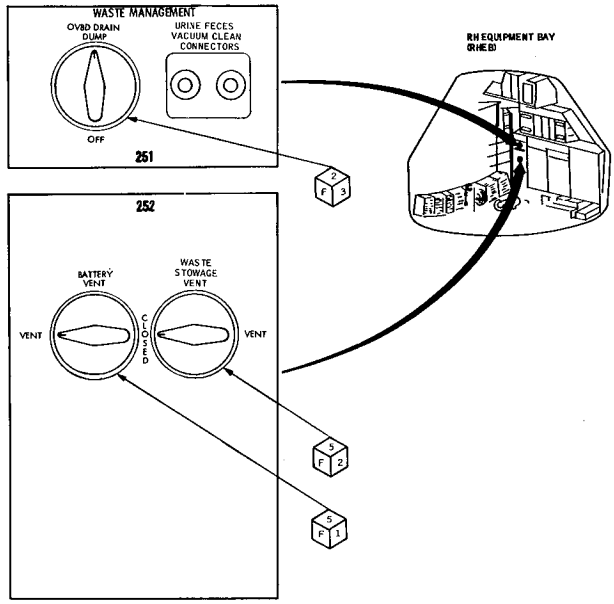
PRESS

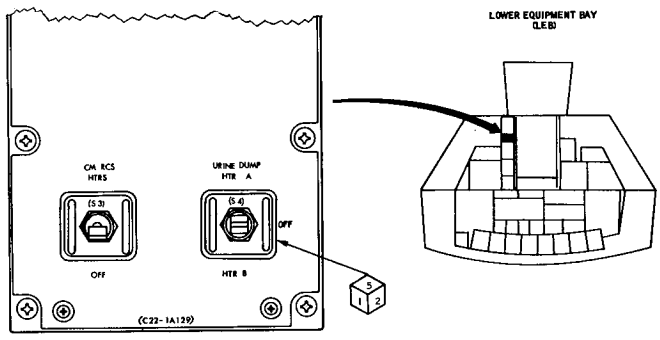
PRIM SEC

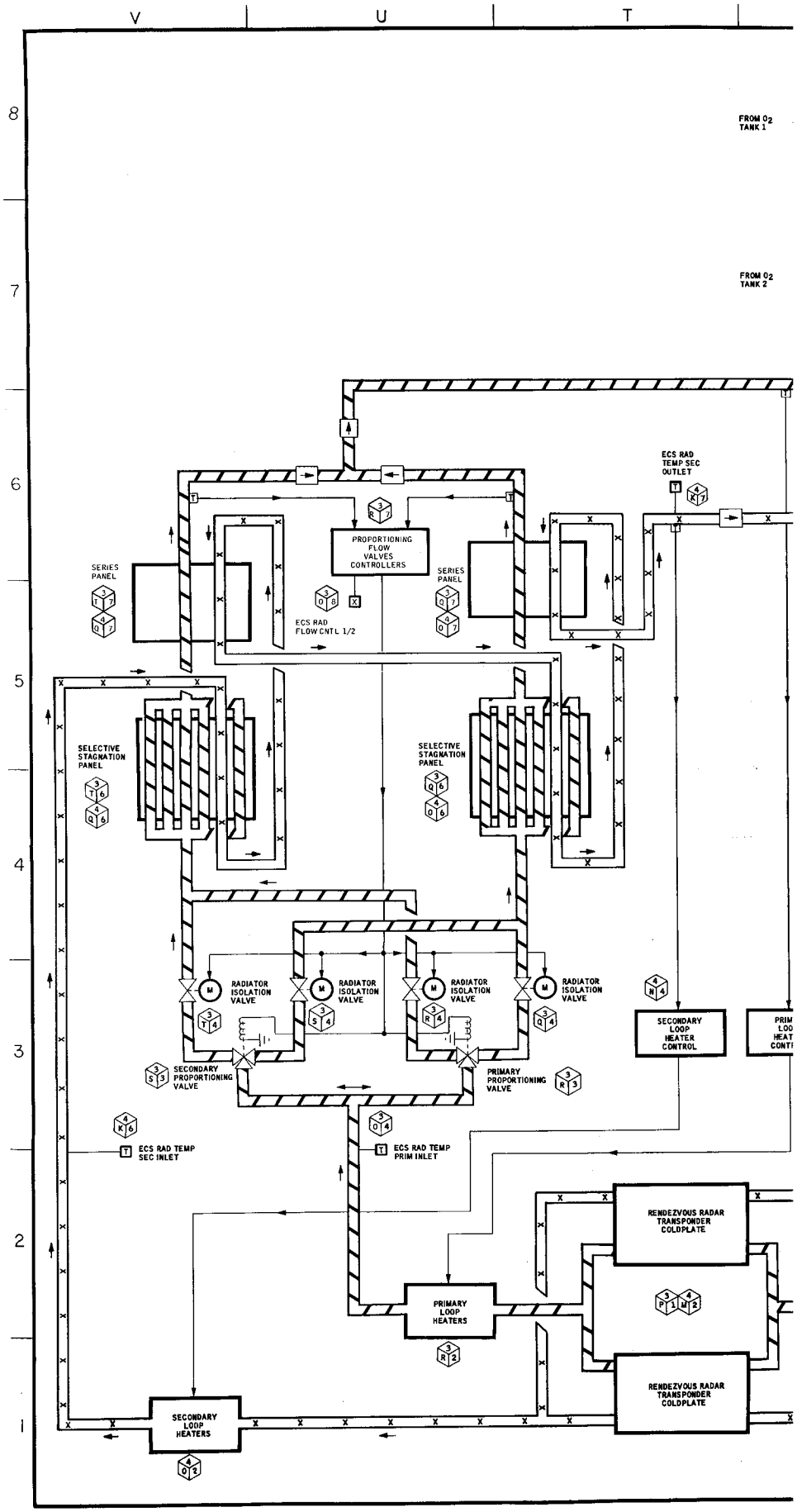
H_2O

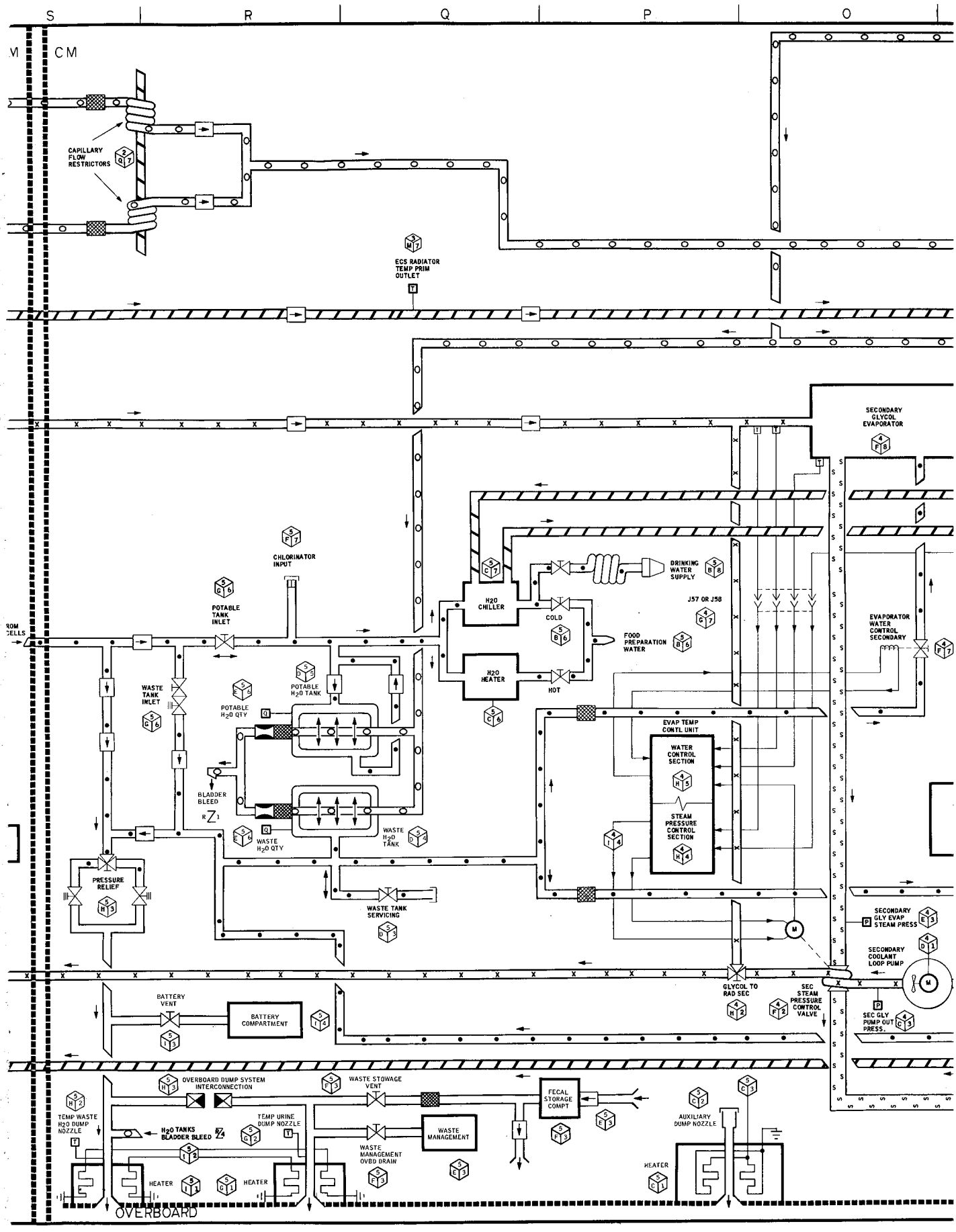
H_2O

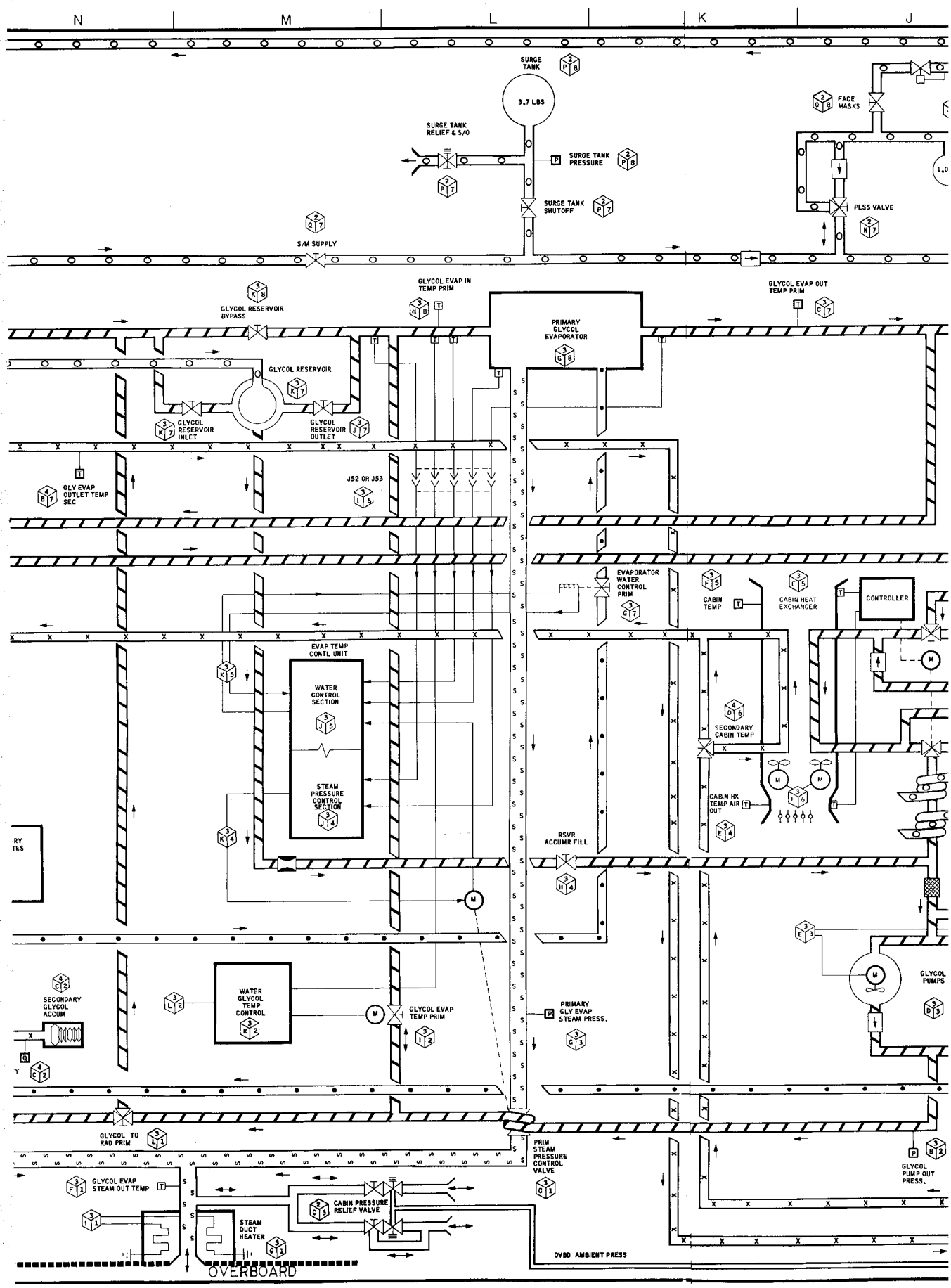


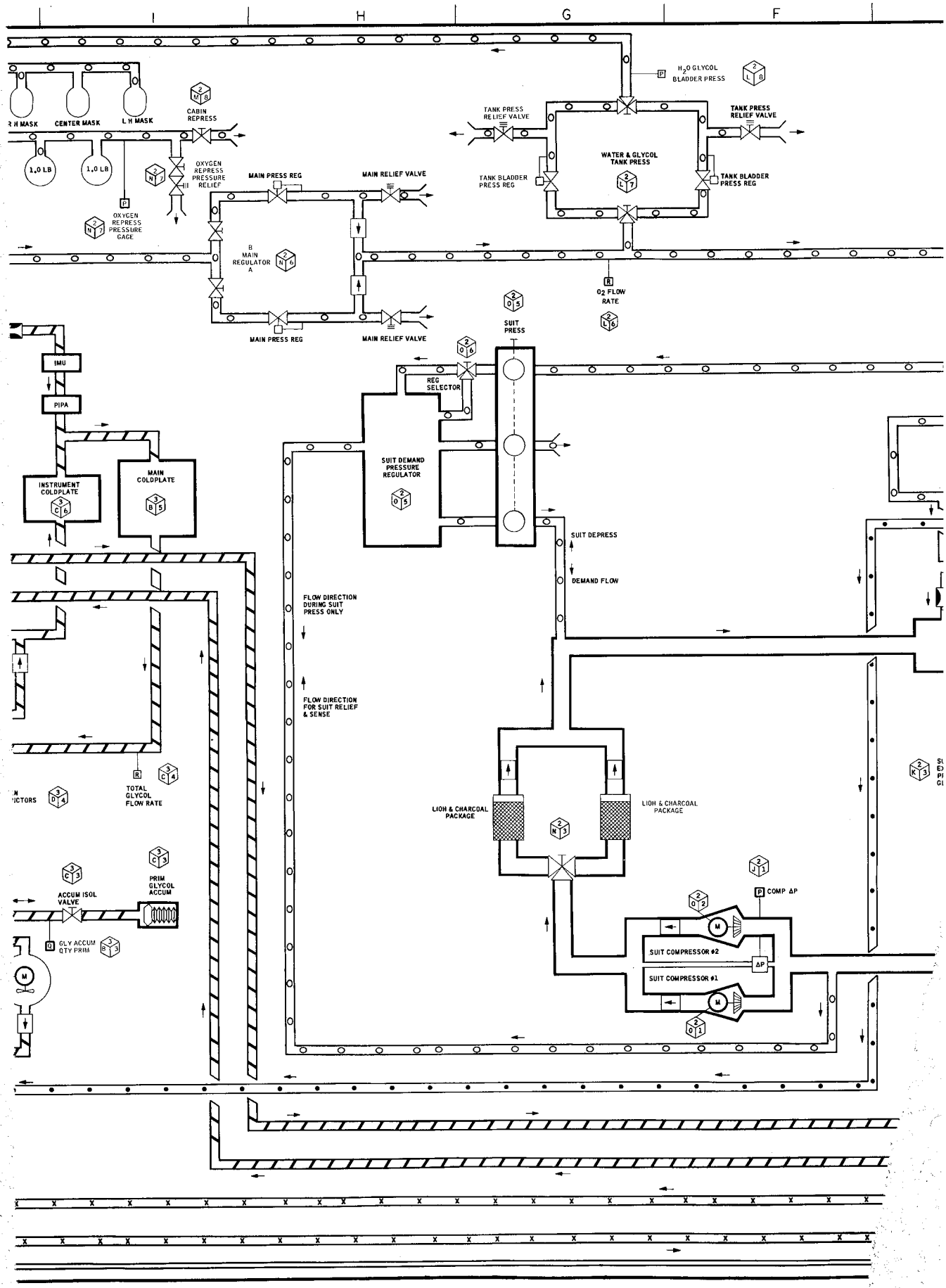


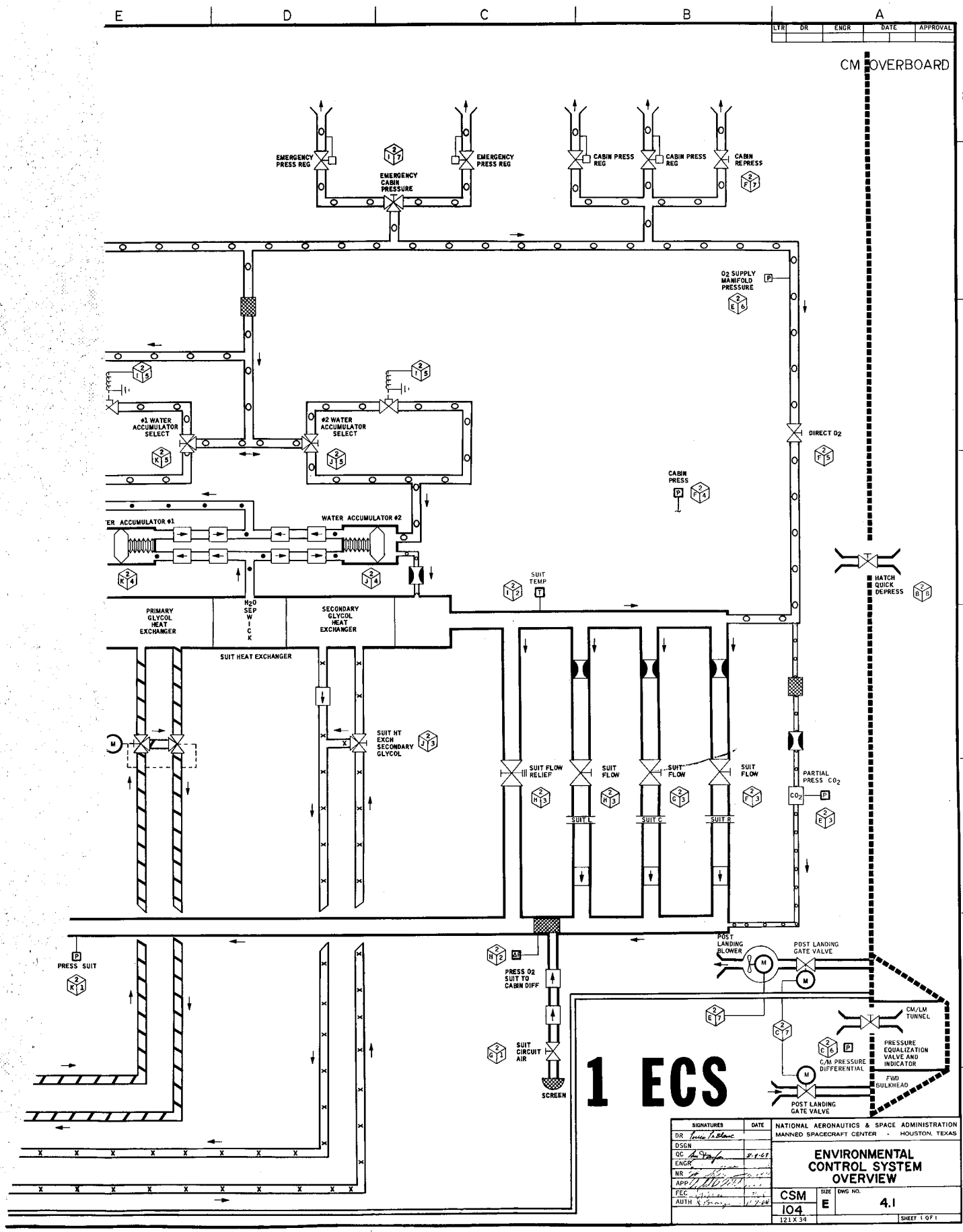



V
U
T
8
7
6
5
4
3
2
1
FROM O2 TANK 1
FROM O2 TANK 2
ECS RAD TEMP SEC OUTLET
PROPORTIONING FLOW VALVES CONTROLLERS
SERIES PANEL
SERIES PANEL
ECS RAD FLOW CNTL 1/2
SELECTIVE STAGNATION PANEL
SELECTIVE STAGNATION PANEL
RADIATOR ISOLATION VALVE
RADIATOR ISOLATION VALVE
RADIATOR ISOLATION VALVE
RADIATOR ISOLATION VALVE
SECONDARY LOOP HEATER CONTROL
SECONDARY PROPORTIONING VALVE
PRIMARY PROPORTIONING VALVE
ECS RAD TEMP SEC INLET
ECS RAD TEMP PRIM INLET
RENDEZVOUS RADAR TRANSPONDER COLDPLATE
PRIMARY LOOP HEATERS
RENDEZVOUS RADAR TRANSPONDER COLDPLATE
SECONDARY LOOP HEATERS


S
R
Q
P
O
M
CM
CAPILLARY FLOW RESTRICTORS
ECS RADIATOR TEMP PRIM OUTLET
SECONDARY GLYCOL EVAPORATOR
CHLORINATOR INPUT
POTABLE TANK INLET
DRINKING WATER SUPPLY
H2O CHILLER
COLD
J57 OR J58
FOOD PREPARATION WATER
H2O HEATER
HOT
EVAPORATOR WATER CONTROL SECONDARY
WASTE TANK INLET
POTABLE H2O QTY
POTABLE H2O TANK
EVAP TEMP CONTL UNIT
WATER CONTROL SECTION
STEAM PRESSURE CONTROL SECTION
BLADDER BLEED
WASTE H2O QTY
WASTE H2O TANK
PRESSURE RELIEF
WASTE TANK SERVICING
SECONDARY GLY EVAP STEAM PRESS
SECONDARY COOLANT LOOP PUMP
GLYCOL TO RAD SEC
SEC STEAM PRESSURE CONTROL VALVE
SEC GLY PUMP OUT PRESS.
BATTERY VENT
BATTERY COMPARTMENT
OVERBOARD DUMP SYSTEM INTERCONNECTION
WASTE STOWAGE VENT
FECAL STORAGE COMPT
AUXILIARY DUMP NOZZLE
TEMP WASTE H2O DUMP NOZZLE
H2O TANKS BLADDER BLEED
TEMP URINE DUMP NOZZLE
WASTE MANAGEMENT
WASTE MANAGEMENT OVBD DRAIN
HEATER
HEATER
HEATER
OVERBOARD


N
M
L
K
J
SURGE TANK
3.7 LBS
SURGE TANK RELIEF & S/O
SURGE TANK PRESSURE
SURGE TANK SHUTOFF
FACE MASKS
PLSS VALVE
S/M SUPPLY
GLYCOL RESERVOIR BYPASS
GLYCOL EVAP IN TEMP PRIM
GLYCOL EVAP OUT TEMP PRIM
PRIMARY GLYCOL EVAPORATOR
GLYCOL RESERVOIR
GLYCOL RESERVOIR INLET
GLYCOL RESERVOIR OUTLET
GLY EVAP OUTLET TEMP SEC
J52 OR J53
EVAPORATOR WATER CONTROL PRIM
CABIN TEMP
CABIN HEAT EXCHANGER
CONTROLLER
EVAP TEMP CONTL UNIT
WATER CONTROL SECTION
STEAM PRESSURE CONTROL SECTION
SECONDARY CABIN TEMP
CABIN HX TEMP AIR OUT
RSVR ACCUMR FILL
SECONDARY GLYCOL ACCUM
WATER GLYCOL TEMP CONTROL
GLYCOL EVAP TEMP PRIM
PRIMARY GLY EVAP STEAM PRESS.
GLYCOL PUMPS
GLYCOL TO RAD PRIM
PRIM STEAM PRESSURE CONTROL VALVE
GLYCOL EVAP STEAM OUT TEMP
CABIN PRESSURE RELIEF VALVE
STEAM DUCT HEATER
GLYCOL PUMP OUT PRESS.
OVBD AMBIENT PRESS
OVERBOARD

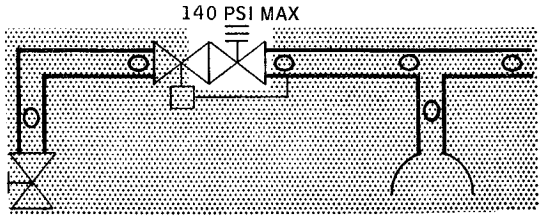

I
H
G
F
R H MASK
CENTER MASK
L H MASK
CABIN REPRESS
1.0 LB
1.0 LB
OXYGEN REPRESS PRESSURE RELIEF
OXYGEN REPRESS PRESSURE GAGE
MAIN PRESS REG
MAIN RELIEF VALVE
B MAIN REGULATOR A
MAIN PRESS REG
MAIN RELIEF VALVE
H2O GLYCOL BLADDER PRESS
TANK PRESS RELIEF VALVE
TANK PRESS RELIEF VALVE
WATER & GLYCOL TANK PRESS
TANK BLADDER PRESS REG
TANK BLADDER PRESS REG
O2 FLOW RATE
SUIT PRESS
REG SELECTOR
SUIT DEMAND PRESSURE REGULATOR
IMU
PIPA
INSTRUMENT COLDPLATE
MAIN COLDPLATE
SUIT DEPRESS
DEMAND FLOW
FLOW DIRECTION DURING SUIT PRESS ONLY
FLOW DIRECTION FOR SUIT RELIEF & SENSE
TOTAL GLYCOL FLOW RATE
LIOH & CHARCOAL PACKAGE
LIOH & CHARCOAL PACKAGE
ACCUM ISOL VALVE
PRIM GLYCOL ACCUM
GLY ACCUM QTY PRIM
COMP ΔP
SUIT COMPRESSOR #2
SUIT COMPRESSOR #1
ΔP


E
D
C
B
A
LTR
DR
ENGR
DATE
APPROVAL
CM OVERBOARD
EMERGENCY PRESS REG
EMERGENCY CABIN PRESSURE
EMERGENCY PRESS REG
CABIN PRESS REG
CABIN PRESS REG
CABIN REPRESS
O2 SUPPLY MANIFOLD PRESSURE
#1 WATER ACCUMULATOR SELECT
#2 WATER ACCUMULATOR SELECT
DIRECT O2
CABIN PRESS
WATER ACCUMULATOR #1
WATER ACCUMULATOR #2
SUIT TEMP
HATCH QUICK DEPRESS
PRIMARY GLYCOL HEAT EXCHANGER
H2O SEP WICK
SECONDARY GLYCOL HEAT EXCHANGER
SUIT HEAT EXCHANGER
SUIT HT EXCH SECONDARY GLYCOL
SUIT FLOW RELIEF
SUIT FLOW
SUIT FLOW
SUIT FLOW
SUIT L
SUIT C
SUIT R
PARTIAL PRESS CO2
PRESS SUIT
PRESS O2 SUIT TO CABIN DIFF
POST LANDING BLOWER
POST LANDING GATE VALVE
CM/LM TUNNEL
PRESSURE EQUALIZATION VALVE AND INDICATOR
C/M PRESSURE DIFFERENTIAL
FWD BULKHEAD
POST LANDING GATE VALVE
SUIT CIRCUIT AIR
SCREEN
1 ECS
SIGNATURES
DATE
DR
DSGN
QC
ENGR
NR
APP
FEC
AUTH
NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER - HOUSTON, TEXAS
ENVIRONMENTAL CONTROL SYSTEM OVERVIEW
CSM
104
SIZE
E
DWG NO.
4.1
121 X 34
SHEET 1 OF 1

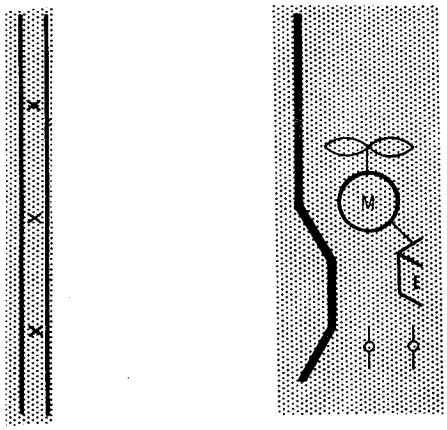
SECTION 4

IS

1. DWG 4.1 J Z 8



2. DWG 4.1 K Z 4



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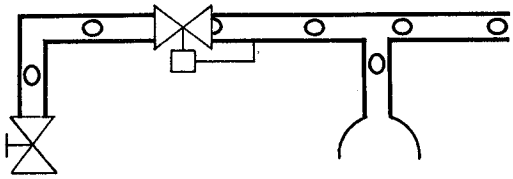
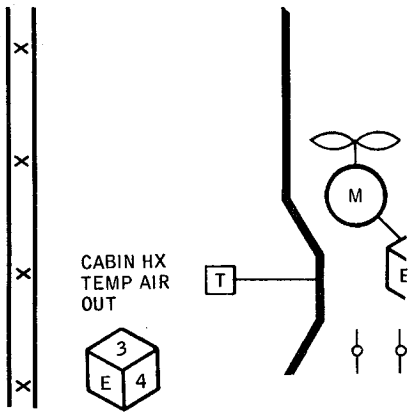
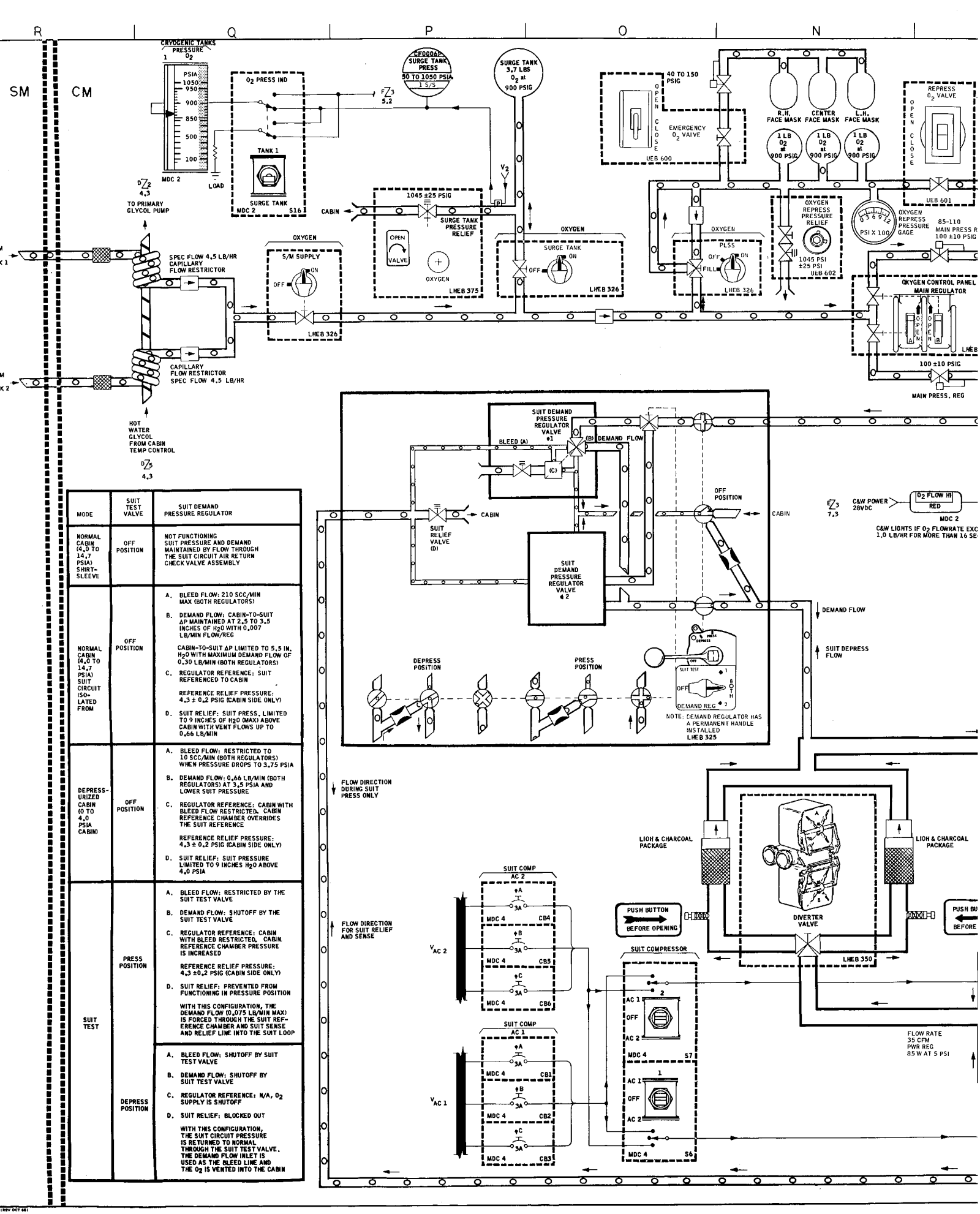
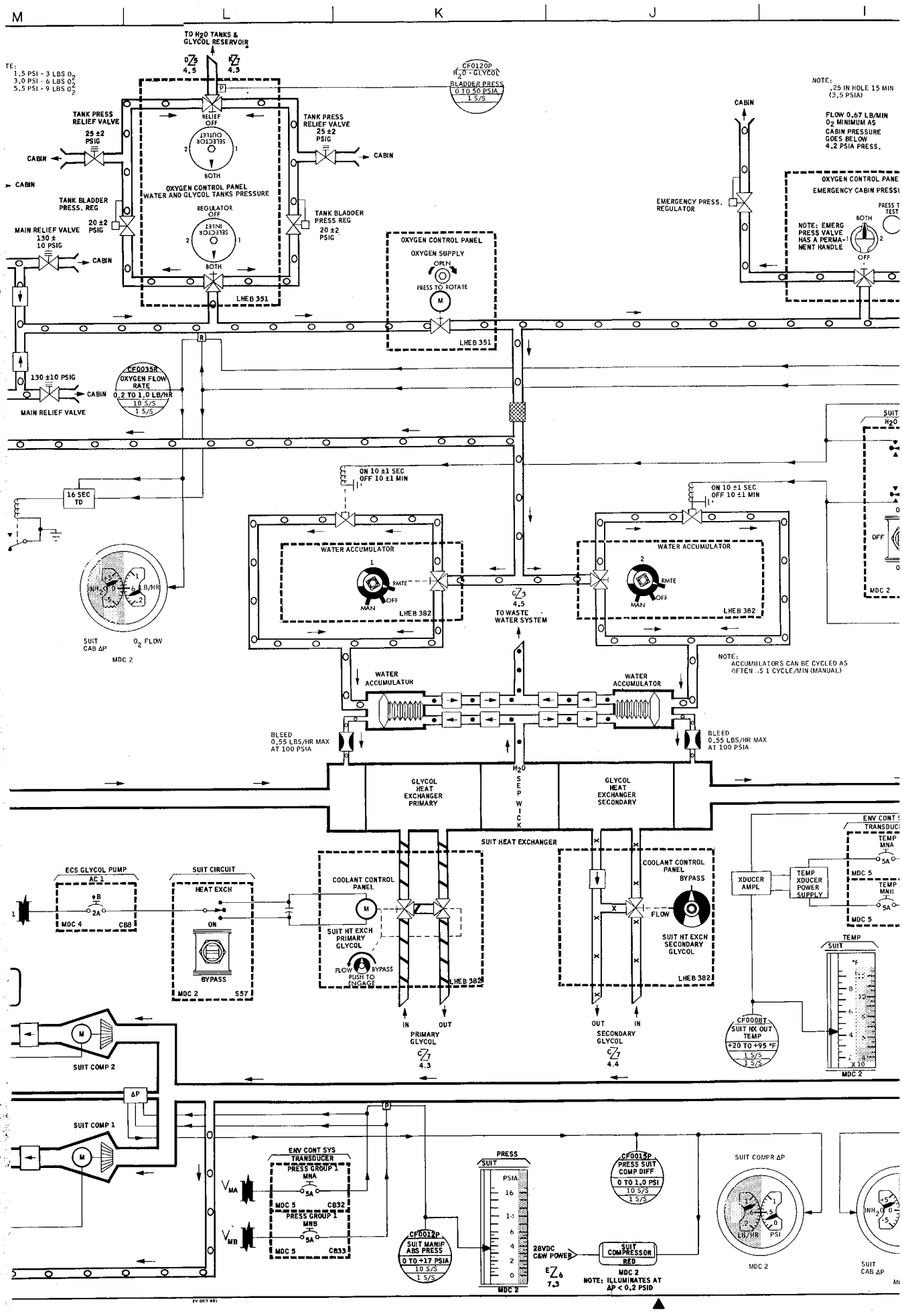


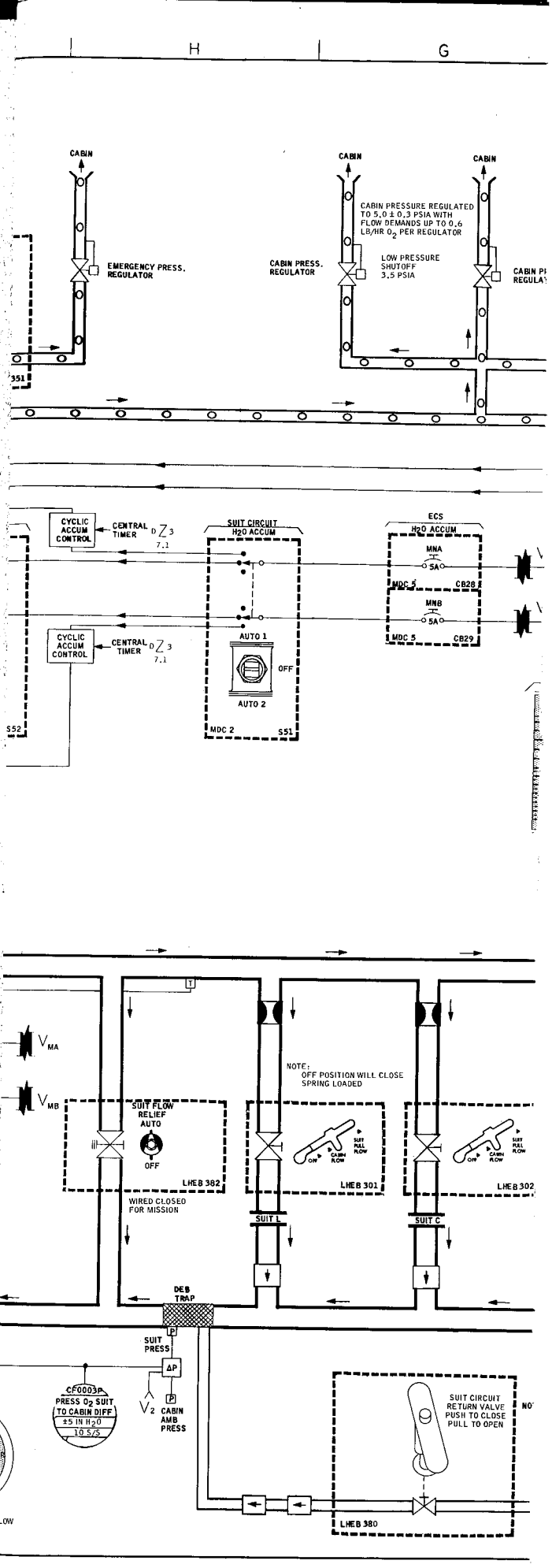


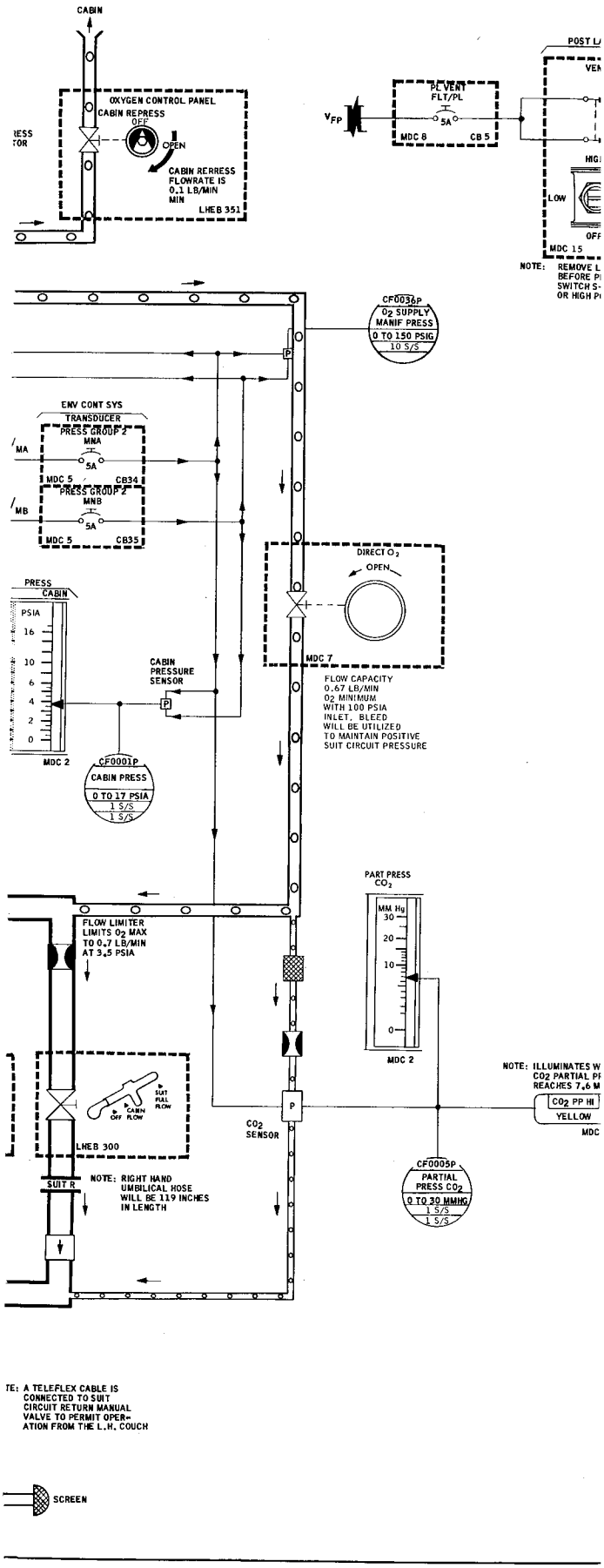


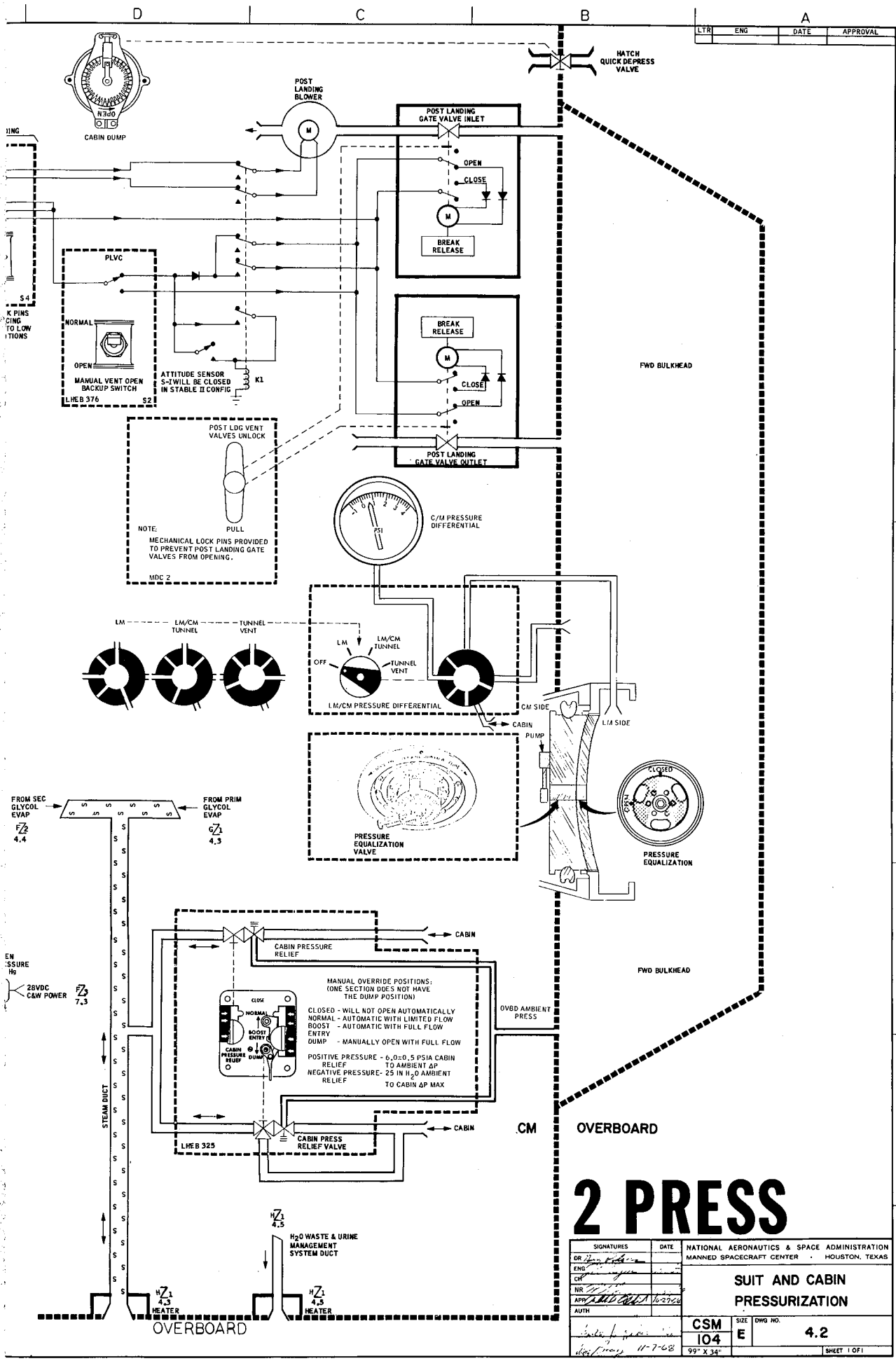
MODE	SUIT TEST VALVE	SUIT DEMAND PRESSURE REGULATOR
NORMAL CABIN (4.0 TO 14.7 PSIA) SHIRT-SLEEVE	OFF POSITION	NOT FUNCTIONING SUIT PRESSURE AND DEMAND MAINTAINED BY FLOW THROUGH THE SUIT CIRCUIT AIR RETURN CHECK VALVE ASSEMBLY
NORMAL CABIN (4.0 TO 14.7 PSIA) SUIT CIRCUIT ISOLATED FROM	OFF POSITION	A. BLEED FLOW: 210 SCC/MIN MAX (BOTH REGULATORS) B. DEMAND FLOW: CABIN-TO-SUIT ΔP MAINTAINED AT 2.5 TO 3.5 INCHES OF H_2O WITH 0.007 LB/MIN FLOW/REG CABIN-TO-SUIT ΔP LIMITED TO 5.5 IN. H_2O WITH MAXIMUM DEMAND FLOW OF 0.30 LB/MIN (BOTH REGULATORS) C. REGULATOR REFERENCE: SUIT REFERENCED TO CABIN REFERENCE RELIEF PRESSURE: 4.3 ± 0.2 PSIG (CABIN SIDE ONLY) D. SUIT RELIEF: SUIT PRESS. LIMITED TO 9 INCHES OF H_2O (MAX) ABOVE CABIN WITH VENT FLOWS UP TO 0.66 LB/MIN
DEPRESSURIZED CABIN (0 TO 4.0 PSIA CABIN)	OFF POSITION	A. BLEED FLOW: RESTRICTED TO 10 SCC/MIN (BOTH REGULATORS) WHEN PRESSURE DROPS TO 3.75 PSIA B. DEMAND FLOW: 0.66 LB/MIN (BOTH REGULATORS) AT 3.5 PSIA AND LOWER SUIT PRESSURE C. REGULATOR REFERENCE: CABIN WITH BLEED FLOW RESTRICTED. CABIN REFERENCE CHAMBER OVERRIDES THE SUIT REFERENCE REFERENCE RELIEF PRESSURE: 4.3 ± 0.2 PSIG (CABIN SIDE ONLY) D. SUIT RELIEF: SUIT PRESSURE LIMITED TO 9 INCHES H_2O ABOVE 4.0 PSIA
SUIT TEST	PRESS POSITION	A. BLEED FLOW: RESTRICTED BY THE SUIT TEST VALVE B. DEMAND FLOW: SHUTOFF BY THE SUIT TEST VALVE C. REGULATOR REFERENCE: CABIN WITH BLEED RESTRICTED. CABIN REFERENCE CHAMBER PRESSURE IS INCREASED REFERENCE RELIEF PRESSURE: 4.3 ± 0.2 PSIG (CABIN SIDE ONLY) D. SUIT RELIEF: PREVENTED FROM FUNCTIONING IN PRESSURE POSITION WITH THIS CONFIGURATION, THE DEMAND FLOW (0.075 LB/MIN MAX) IS FORCED THROUGH THE SUIT REFERENCE CHAMBER AND SUIT SENSE AND RELIEF LINE INTO THE SUIT LOOP
	DEPRESS POSITION	A. BLEED FLOW: SHUTOFF BY SUIT TEST VALVE B. DEMAND FLOW: SHUTOFF BY SUIT TEST VALVE C. REGULATOR REFERENCE: N/A, O_2 SUPPLY IS SHUTOFF D. SUIT RELIEF: BLOCKED OUT WITH THIS CONFIGURATION, THE SUIT CIRCUIT PRESSURE IS RETURNED TO NORMAL THROUGH THE SUIT TEST VALVE. THE DEMAND FLOW INLET IS USED AS THE BLEED LINE AND THE O_2 IS VENTED INTO THE CABIN

(REV OCT 68)


M
L
K
J
I
TO H2O TANKS & GLYCOL RESERVOIR
TE:
1.5 PSI - 3 LBS O2
3.0 PSI - 6 LBS O2
5.5 PSI - 9 LBS O2
CF0120P
H2O - GLYCOL BLADDER PRESS
0 TO 50 PSIA
1 S/S
TANK PRESS RELIEF VALVE
25 ±2 PSIG
CABIN
OXYGEN CONTROL PANEL
WATER AND GLYCOL TANKS PRESSURE
REGULATOR
SELECTOR INLET
RELIEF OFF
SELECTOR OUTLET
BOTH
TANK BLADDER PRESS. REG
20 ±2 PSIG
MAIN RELIEF VALVE
130 ± 10 PSIG
LHEB 351
OXYGEN CONTROL PANEL
OXYGEN SUPPLY
OPEN
PRESS TO ROTATE
NOTE:
.25 IN HOLE 15 MIN (3.5 PSIA)
FLOW 0.67 LB/MIN O2 MINIMUM AS CABIN PRESSURE GOES BELOW 4.2 PSIA PRESS.
EMERGENCY PRESS. REGULATOR
NOTE: EMERG PRESS VALVE HAS A PERMANENT HANDLE
130 ±10 PSIG
CF0035R
OXYGEN FLOW RATE
0.2 TO 1.0 LB/HR
10 S/S
1 S/S
16 SEC TD
ON 10 ±1 SEC
OFF 10 ±1 MIN
WATER ACCUMULATOR
RMTE
MAN
OFF
LHEB 382
TO WASTE WATER SYSTEM
SUIT CAB ΔP
O2 FLOW
MDC 2
NOTE:
ACCUMULATORS CAN BE CYCLED AS OFTEN AS 1 CYCLE/MIN (MANUAL)
BLEED
0.55 LBS/HR MAX AT 100 PSIA
GLYCOL HEAT EXCHANGER PRIMARY
GLYCOL HEAT EXCHANGER SECONDARY
H2O SEP WICK
SUIT HEAT EXCHANGER
ECS GLYCOL PUMP
AC 1
MDC 4
CB8
SUIT CIRCUIT
HEAT EXCH
ON
BYPASS
MDC 2
S57
COOLANT CONTROL PANEL
SUIT HT EXCH PRIMARY GLYCOL
FLOW
BYPASS
PUSH TO ENGAGE
SUIT HT EXCH SECONDARY GLYCOL
IN
OUT
PRIMARY GLYCOL
SECONDARY GLYCOL
XDUCER AMPL
TEMP XDUCER POWER SUPPLY
TEMP MNA
TEMP MNB
5A
CF0008T
SUIT HX OUT TEMP
+20 TO +95 °F
TEMP SUIT
SUIT COMP 2
SUIT COMP 1
ΔP
ENV CONT SYS TRANSDUCER
PRESS GROUP 1 MNA
PRESS GROUP 1 MNB
CB32
CB33
CF0013P
SUIT MANIF ABS PRESS
0 TO +17 PSIA
PRESS SUIT
PSIA
CF0012P
PRESS SUIT COMP DIFF
0 TO 1.0 PSI
28VDC C&W POWER
SUIT COMPRESSOR RED
MDC 2
NOTE: ILLUMINATES AT ΔP < 0.2 PSID
SUIT COMPR ΔP
LB/HR
PSI
SUIT CAB ΔP


H
G
CABIN
EMERGENCY PRESS. REGULATOR
351
CABIN
CABIN
CABIN PRESSURE REGULATED TO 5.0 ± 0.3 PSIA WITH FLOW DEMANDS UP TO 0.6 LB/HR O_2 PER REGULATOR
CABIN PRESS. REGULATOR
LOW PRESSURE SHUTOFF 3.5 PSIA
CABIN PR REGULA
CYCLIC ACCUM CONTROL
CENTRAL TIMER
SUIT CIRCUIT H2O ACCUM
ECS H2O ACCUM
MNA
5A
MDC 5
CB28
MNB
5A
MDC 5
CB29
CYCLIC ACCUM CONTROL
CENTRAL TIMER
AUTO 1
OFF
AUTO 2
S52
MDC 2
S51
V_{MA}
V_{MB}
NOTE:
OFF POSITION WILL CLOSE SPRING LOADED
SUIT FLOW RELIEF AUTO
OFF
LHEB 382
WIRED CLOSED FOR MISSION
LHEB 301
LHEB 302
SUIT L
SUIT C
DEB TRAP
SUIT PRESS
ΔP
CF0003P
PRESS O_2 SUIT TO CABIN DIFF
±5 IN H_2O
10 S/S
V_2
CABIN AMB PRESS
SUIT CIRCUIT RETURN VALVE PUSH TO CLOSE PULL TO OPEN
LHEB 380


F
E
CABIN
OXYGEN CONTROL PANEL
CABIN REPRESS
OFF
OPEN
CABIN REPRESS FLOWRATE IS 0.1 LB/MIN MIN
LHEB 351
PC VENT FLT/PL
5A
MDC 8
CB 5
POST L
VEN
HIGH
LOW
OFF
MDC 15
NOTE: REMOVE L BEFORE P SWITCH S- OR HIGH P
CF0036P
O2 SUPPLY MANIF PRESS
0 TO 150 PSIG
10 S/S
ENV CONT SYS
TRANSDUCER
PRESS GROUP 2 MNA
5A
MDC 5
CB34
PRESS GROUP 2 MNB
5A
MDC 5
CB35
DIRECT O2
OPEN
MDC 7
FLOW CAPACITY 0.67 LB/MIN O2 MINIMUM WITH 100 PSIA INLET. BLEED WILL BE UTILIZED TO MAINTAIN POSITIVE SUIT CIRCUIT PRESSURE
PRESS CABIN
PSIA
16
10
6
4
2
0
MDC 2
CABIN PRESSURE SENSOR
CF0001P
CABIN PRESS
0 TO 17 PSIA
1 S/S
1 S/S
PART PRESS CO2
MM Hg
30
20
10
0
MDC 2
FLOW LIMITER LIMITS O2 MAX TO 0.7 LB/MIN AT 3.5 PSIA
SUIT FULL FLOW
CABIN FLOW
OFF
LHEB 300
CO2 SENSOR
NOTE: ILLUMINATES W CO2 PARTIAL PR REACHES 7.6 M
CO2 PP HI
YELLOW
MDC
CF0005P
PARTIAL PRESS CO2
0 TO 30 MMHG
1 S/S
1 S/S
SUIT R
NOTE: RIGHT HAND UMBILICAL HOSE WILL BE 119 INCHES IN LENGTH
TE: A TELEFLEX CABLE IS CONNECTED TO SUIT CIRCUIT RETURN MANUAL VALVE TO PERMIT OPER- ATION FROM THE L.H. COUCH
SCREEN

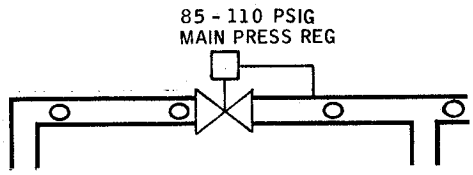


2 PRESS

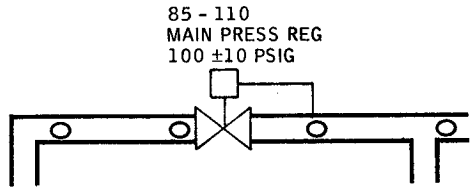
SIGNATURES	DATE	NATIONAL AERONAUTICS & SPACE ADMINISTRATION
DR		MANNED SPACECRAFT CENTER · HOUSTON, TEXAS
ENG		SUIT AND CABIN PRESSURIZATION
CH		
NR		
APP	11-27-68	
AUTH		CSM 104 · SIZE E · DWG NO. 4.2
	11-7-68	99" X 34" · SHEET 1 OF 1

IS

5. DWG 4.2 M Z 7



WAS



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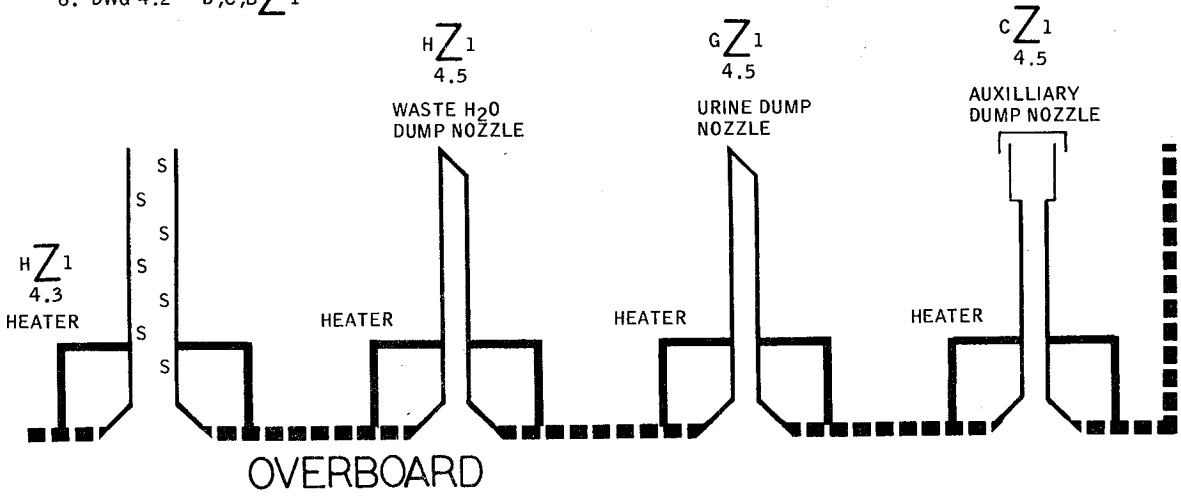
6. DWG 4.2 D,C,B Z 1



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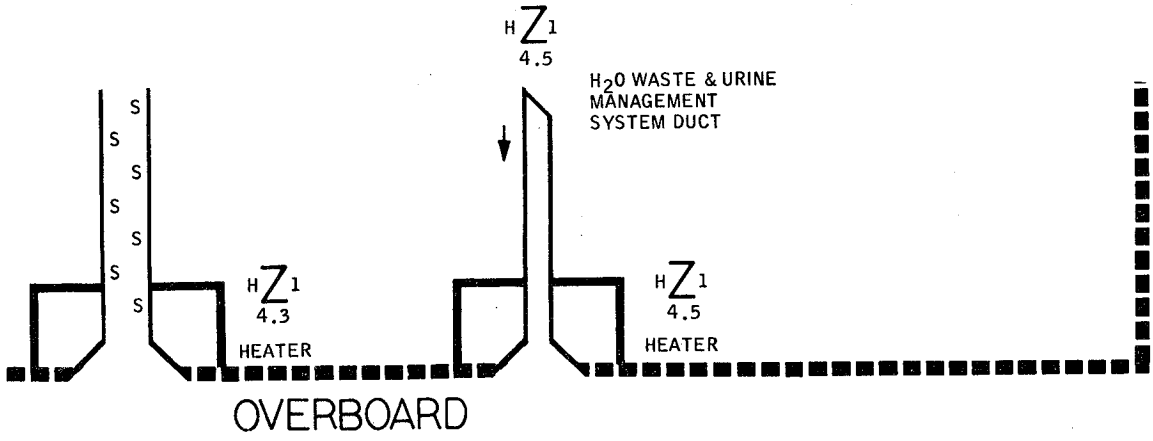
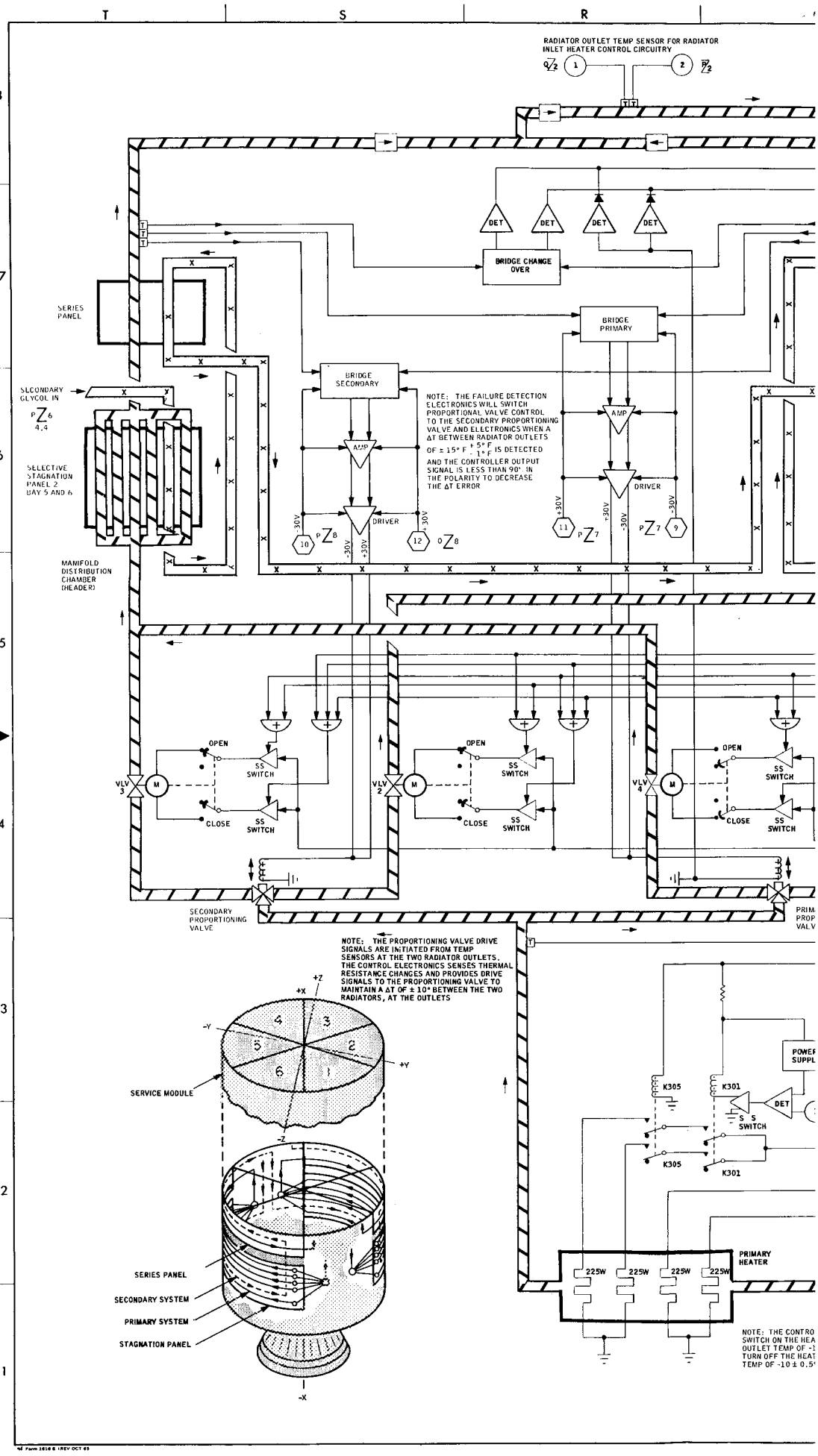
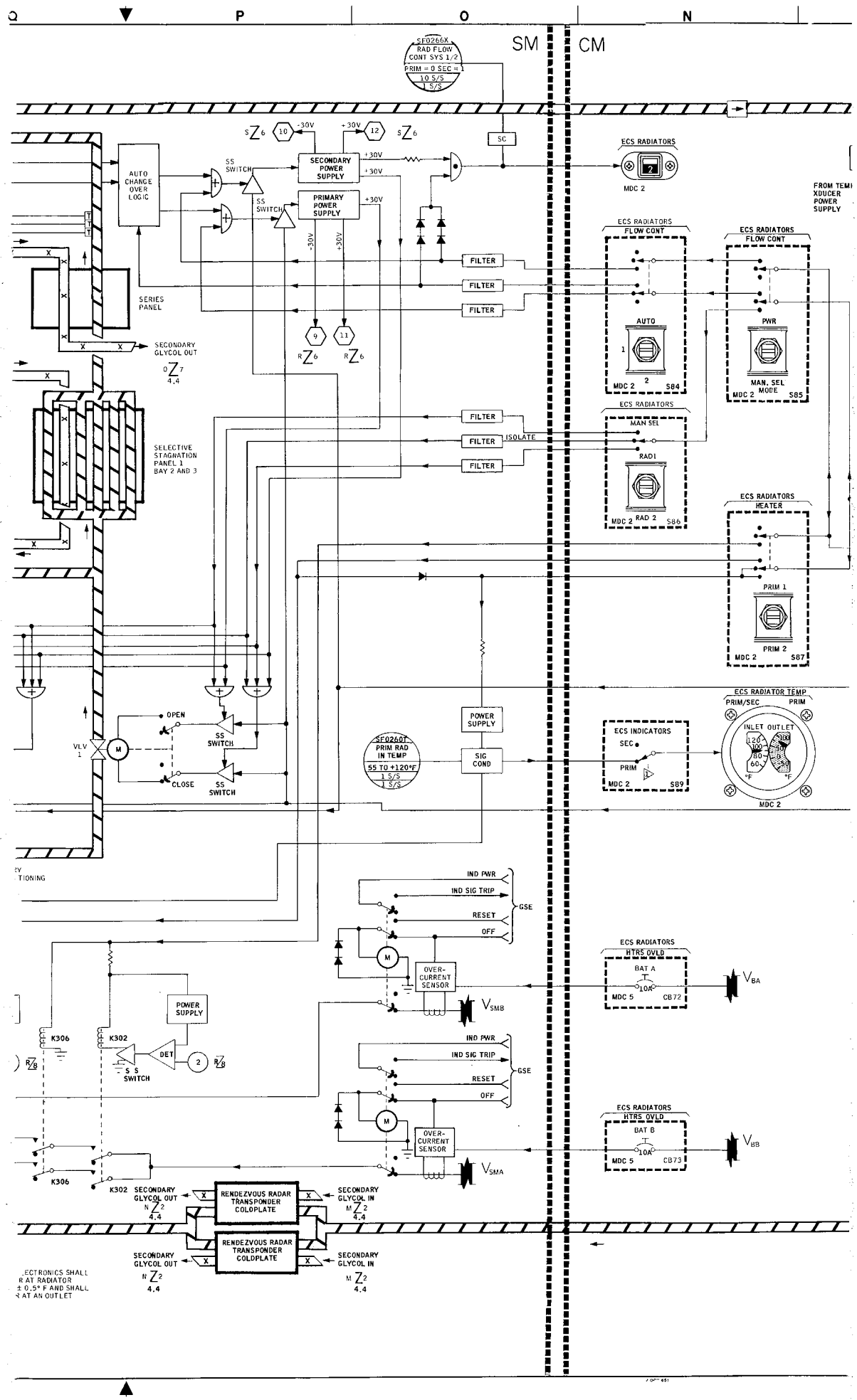
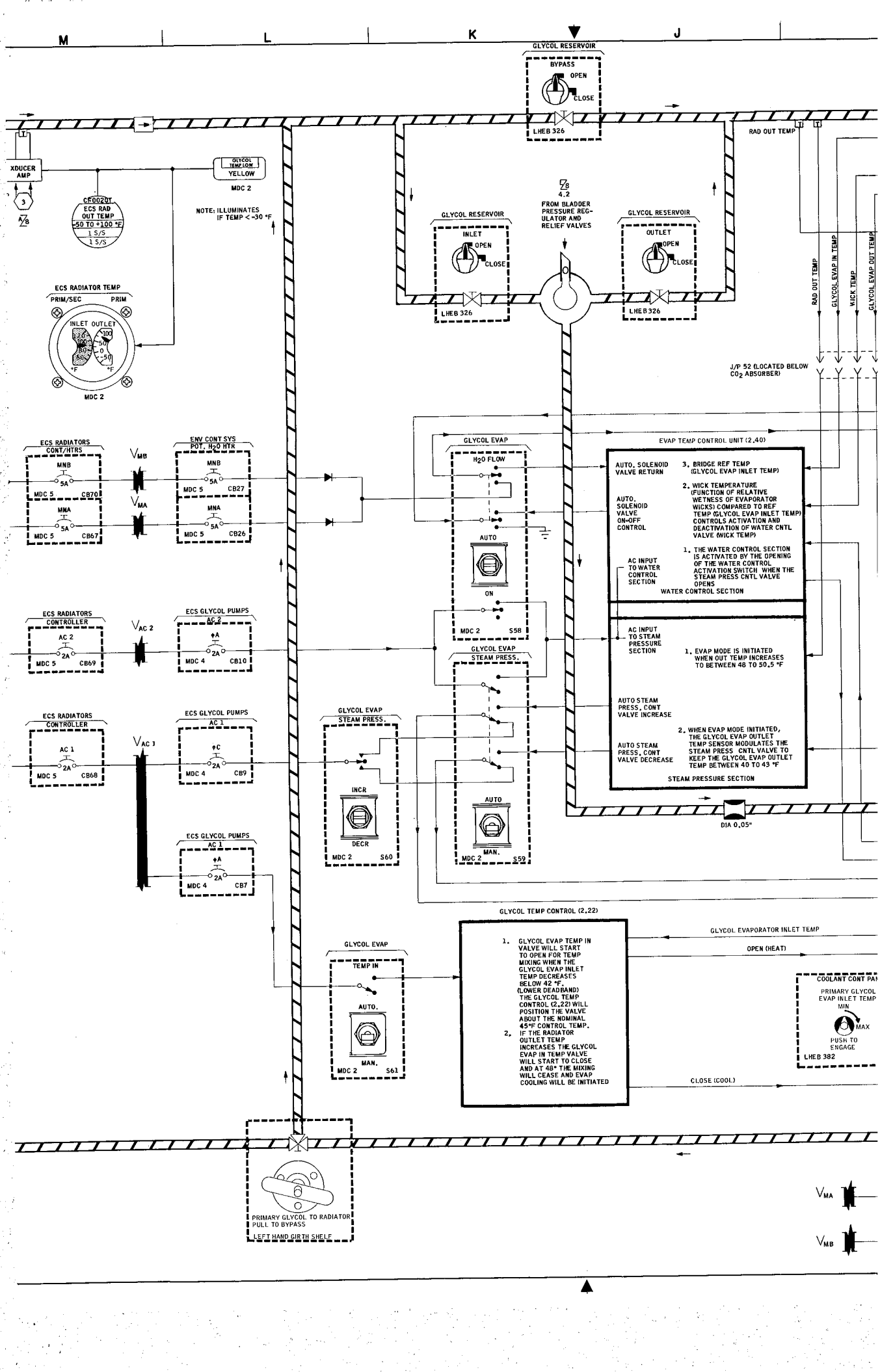
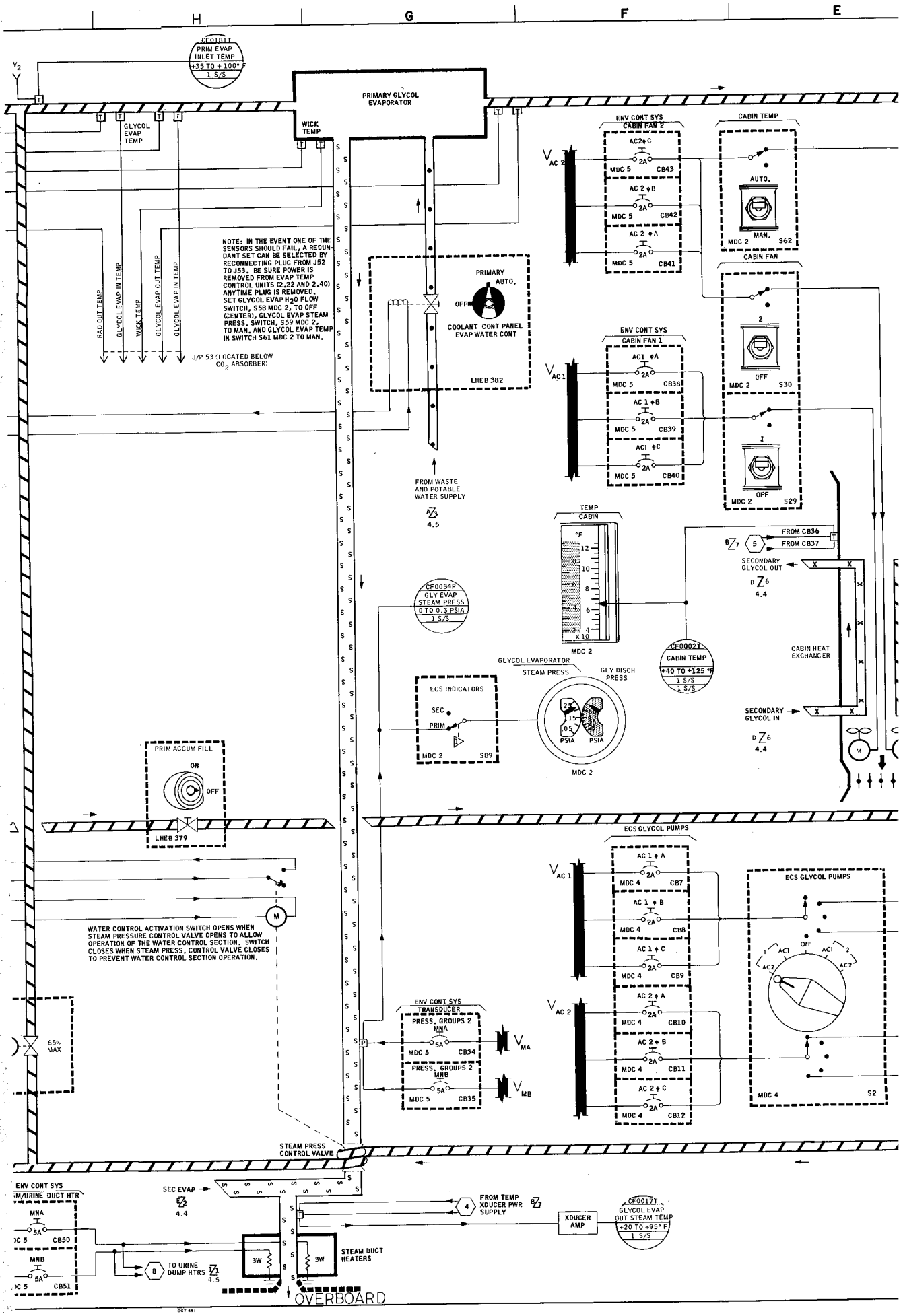
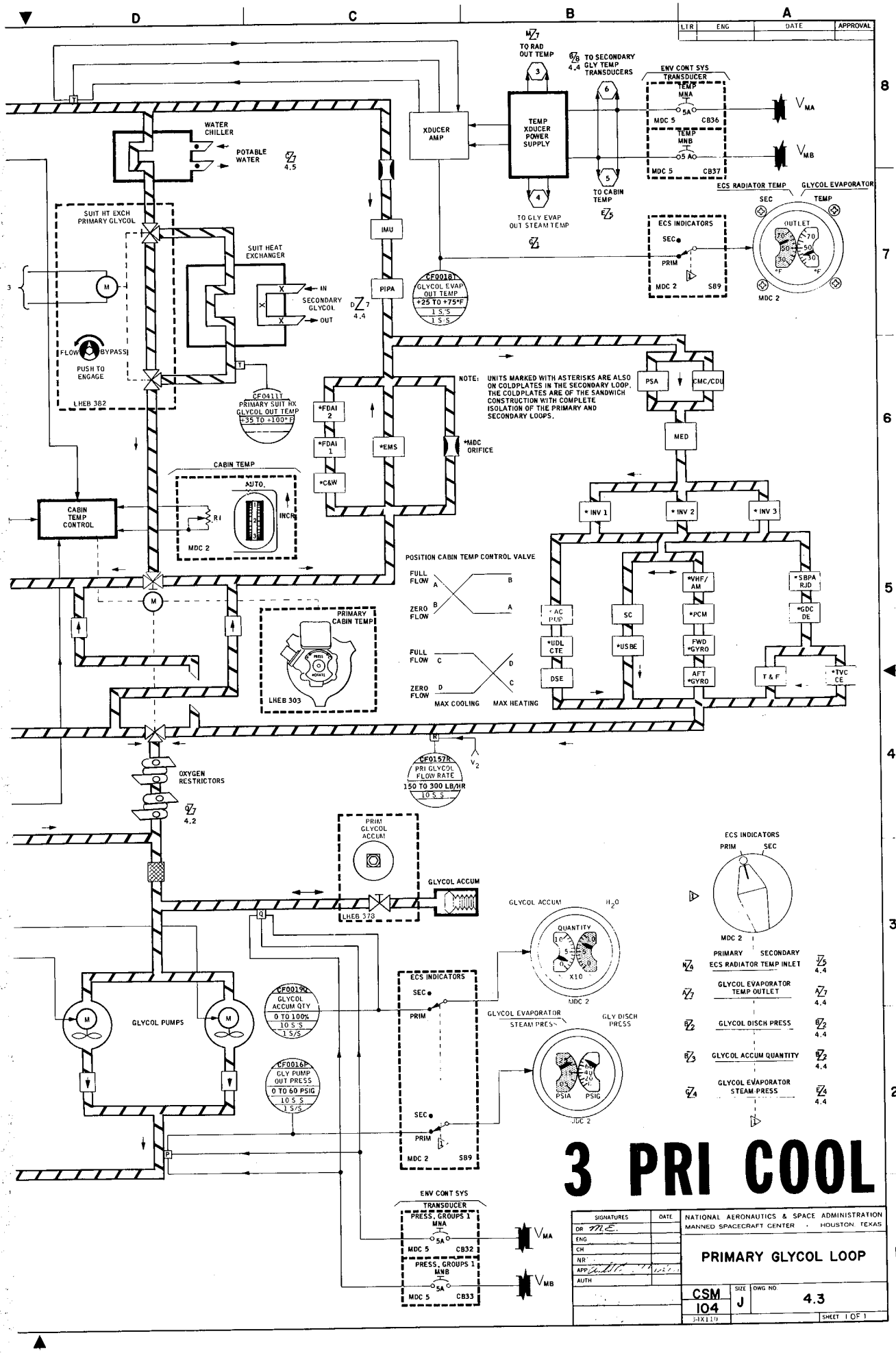



T
S
R
8
7
6
5
4
3
2
1
RADIATOR OUTLET TEMP SENSOR FOR RADIATOR INLET HEATER CONTROL CIRCUITRY
DET
DET
DET
DET
BRIDGE CHANGE OVER
SERIES PANEL
BRIDGE PRIMARY
BRIDGE SECONDARY
SECONDARY GLYCOL IN
P Z6 4,4
SELECTIVE STAGNATION PANEL 2 BAY 5 AND 6
NOTE: THE FAILURE DETECTION ELECTRONICS WILL SWITCH PROPORTIONAL VALVE CONTROL TO THE SECONDARY PROPORTIONING VALVE AND ELECTRONICS WHEN A ΔT BETWEEN RADIATOR OUTLETS OF ± 15° F - 1° F IS DETECTED AND THE CONTROLLER OUTPUT SIGNAL IS LESS THAN 90° IN THE POLARITY TO DECREASE THE ΔT ERROR
AMP
DRIVER
AMP
DRIVER
+30V
-30V
10 P Z8
12 O Z8
11 P Z7
P Z7 9
MANIFOLD DISTRIBUTION CHAMBER (HEADER)
OPEN
SS SWITCH
CLOSE
SS SWITCH
VLV 3
VLV 2
VLV 4
SECONDARY PROPORTIONING VALVE
NOTE: THE PROPORTIONING VALVE DRIVE SIGNALS ARE INITIATED FROM TEMP SENSORS AT THE TWO RADIATOR OUTLETS. THE CONTROL ELECTRONICS SENSES THERMAL RESISTANCE CHANGES AND PROVIDES DRIVE SIGNALS TO THE PROPORTIONING VALVE TO MAINTAIN A ΔT OF ± 10° BETWEEN THE TWO RADIATORS, AT THE OUTLETS
+Z
+X
-Y
+Y
-Z
-X
SERVICE MODULE
SERIES PANEL
SECONDARY SYSTEM
PRIMARY SYSTEM
STAGNATION PANEL
K305
K301
DET
S SWITCH
K305
K301
225W
225W
225W
225W
PRIMARY HEATER


SM
CM
SF0266X
RAD FLOW CONT SYS 1/2
PRIM = 0 SEC = 1
10 S/S
1 S/S
AUTO CHANGE OVER LOGIC
SS SWITCH
SECONDARY POWER SUPPLY
PRIMARY POWER SUPPLY
+30V
SC
ECS RADIATORS
MDC 2
FROM TEMP XDUCER POWER SUPPLY
FILTER
SERIES PANEL
SECONDARY GLYCOL OUT
SELECTIVE STAGNATION PANEL 1 BAY 2 AND 3
ISOLATE
ECS RADIATORS FLOW CONT
AUTO
MDC 2 S84
PWR
MAN. SEL MODE
MDC 2 S85
ECS RADIATORS MAN SEL
RAD1
RAD 2
MDC 2 S86
ECS RADIATORS HEATER
PRIM 1
PRIM 2
MDC 2 S87
OPEN
CLOSE
VLV 1
SF0260T
PRIM RAD IN TEMP
55 TO +120°F
POWER SUPPLY
SIG COND
ECS INDICATORS
SEC
PRIM
MDC 2 S89
ECS RADIATOR TEMP
PRIM/SEC
INLET OUTLET
IND PWR
IND SIG TRIP
RESET
OFF
GSE
OVER-CURRENT SENSOR
ECS RADIATORS HTRS OVLD
BAT A
10A
MDC 5 CB72
BAT B
MDC 5 CB73
K306
K302
DET
S S SWITCH
RENDEZVOUS RADAR TRANSPONDER COLDPLATE
SECONDARY GLYCOL IN
SECONDARY GLYCOL OUT
ECTRONICS SHALL
R AT RADIATOR
± 0.5° F AND SHALL
AT AN OUTLET


M
L
K
J
GLYCOL RESERVOIR
BYPASS
OPEN
CLOSE
LHEB 326
RAD OUT TEMP
XDUCER AMP
GLYCOL TEMP LOW
YELLOW
MDC 2
NOTE: ILLUMINATES IF TEMP < -30 °F
CE0020T
ECS RAD OUT TEMP
-50 TO +100 °F
1 S/S
1 S/S
FROM BLADDER PRESSURE REGULATOR AND RELIEF VALVES
GLYCOL RESERVOIR
INLET
OPEN
CLOSE
LHEB 326
GLYCOL RESERVOIR
OUTLET
OPEN
CLOSE
LHEB 326
RAD OUT TEMP
GLYCOL EVAP IN TEMP
WICK TEMP
GLYCOL EVAP OUT TEMP
J/P 52 (LOCATED BELOW CO_2 ABSORBER)
ECS RADIATOR TEMP
PRIM/SEC
PRIM
INLET
OUTLET
MDC 2
ECS RADIATORS CONT/HTRS
MNB
5A
MDC 5
CB70
MNA
5A
MDC 5
CB67
V_{MB}
V_{MA}
ENV CONT SYS POT. H_2O HTR
MNB
5A
MDC 5
CB27
MNA
5A
MDC 5
CB26
GLYCOL EVAP
H_2O FLOW
AUTO
ON
MDC 2
S58
EVAP TEMP CONTROL UNIT (2.40)
AUTO. SOLENOID VALVE RETURN
AUTO. SOLENOID VALVE ON-OFF CONTROL
AC INPUT TO WATER CONTROL SECTION
3. BRIDGE REF TEMP (GLYCOL EVAP INLET TEMP)
2. WICK TEMPERATURE (FUNCTION OF RELATIVE WETNESS OF EVAPORATOR WICKS) COMPARED TO REF TEMP (GLYCOL EVAP INLET TEMP) CONTROLS ACTIVATION AND DEACTIVATION OF WATER CNTL VALVE (WICK TEMP)
1. THE WATER CONTROL SECTION IS ACTIVATED BY THE OPENING OF THE WATER CONTROL ACTIVATION SWITCH WHEN THE STEAM PRESS CNTL VALVE OPENS
WATER CONTROL SECTION
AC INPUT TO STEAM PRESSURE SECTION
1. EVAP MODE IS INITIATED WHEN OUT TEMP INCREASES TO BETWEEN 48 TO 50.5 °F
AUTO STEAM PRESS. CONT VALVE INCREASE
AUTO STEAM PRESS. CONT VALVE DECREASE
2. WHEN EVAP MODE INITIATED, THE GLYCOL EVAP OUTLET TEMP SENSOR MODULATES THE STEAM PRESS CNTL VALVE TO KEEP THE GLYCOL EVAP OUTLET TEMP BETWEEN 40 TO 43 °F
STEAM PRESSURE SECTION
DIA 0.05"
ECS RADIATORS CONTROLLER
AC 2
2A
MDC 5
CB69
$V_{AC\ 2}$
ECS GLYCOL PUMPS
AC 2
A
2A
MDC 4
CB10
GLYCOL EVAP STEAM PRESS.
ECS RADIATORS CONTROLLER
AC 1
2A
MDC 5
CB68
$V_{AC\ 1}$
ECS GLYCOL PUMPS
AC 1
C
2A
MDC 4
CB9
GLYCOL EVAP STEAM PRESS.
INCR
DECR
MDC 2
S60
GLYCOL EVAP STEAM PRESS.
AUTO
MAN.
MDC 2
S59
ECS GLYCOL PUMPS
AC 1
A
2A
MDC 4
CB7
GLYCOL TEMP CONTROL (2.22)
1. GLYCOL EVAP TEMP IN VALVE WILL START TO OPEN FOR TEMP MIXING WHEN THE GLYCOL EVAP INLET TEMP DECREASES BELOW 42 °F. (LOWER DEADBAND) THE GLYCOL TEMP CONTROL (2.22) WILL POSITION THE VALVE ABOUT THE NOMINAL 45°F CONTROL TEMP.
2. IF THE RADIATOR OUTLET TEMP INCREASES THE GLYCOL EVAP IN TEMP VALVE WILL START TO CLOSE AND AT 48° THE MIXING WILL CEASE AND EVAP COOLING WILL BE INITIATED
GLYCOL EVAPORATOR INLET TEMP
OPEN (HEAT)
CLOSE (COOL)
GLYCOL EVAP TEMP IN
AUTO.
MAN.
MDC 2
S61
COOLANT CONT PA
PRIMARY GLYCOL EVAP INLET TEMP
MIN
MAX
PUSH TO ENGAGE
LHEB 382
PRIMARY GLYCOL TO RADIATOR PULL TO BYPASS
LEFT HAND GIRTH SHELF
V_{MA}
V_{MB}


H
G
F
E
CF0181T
PRIM EVAP INLET TEMP
+35 TO + 100° F
1 S/S
PRIMARY GLYCOL EVAPORATOR
WICK TEMP
GLYCOL EVAP TEMP
RAD OUT TEMP
GLYCOL EVAP IN TEMP
WICK TEMP
GLYCOL EVAP OUT TEMP
GLYCOL EVAP IN TEMP
J/P 53 (LOCATED BELOW CO_2 ABSORBER)
NOTE: IN THE EVENT ONE OF THE SENSORS SHOULD FAIL, A REDUNDANT SET CAN BE SELECTED BY RECONNECTING PLUG FROM J52 TO J53. BE SURE POWER IS REMOVED FROM EVAP TEMP CONTROL UNITS (2,22 AND 2,40) ANYTIME PLUG IS REMOVED. SET GLYCOL EVAP H_2O FLOW SWITCH, S58 MDC 2, TO OFF (CENTER); GLYCOL EVAP STEAM PRESS. SWITCH, S59 MDC 2, TO MAN. AND GLYCOL EVAP TEMP IN SWITCH S61 MDC 2 TO MAN.
PRIMARY
AUTO.
OFF
COOLANT CONT PANEL EVAP WATER CONT
LHEB 382
FROM WASTE AND POTABLE WATER SUPPLY
4.5
ENV CONT SYS CABIN FAN 2
$V_{AC 2}$
AC2 ϕC
2A
MDC 5
CB43
AC 2 ϕB
CB42
AC 2 ϕA
CB41
CABIN TEMP
AUTO.
MAN.
MDC 2
S62
CABIN FAN
2
OFF
MDC 2
S30
1
OFF
MDC 2
S29
ENV CONT SYS CABIN FAN 1
$V_{AC 1}$
AC1 ϕA
CB38
AC 1 ϕB
CB39
AC1 ϕC
CB40
TEMP CABIN
°F
MDC 2
FROM CB36
FROM CB37
SECONDARY GLYCOL OUT
4.4
CF0034P
GLY EVAP STEAM PRESS
0 TO 0.3 PSIA
1 S/S
CF0002T
CABIN TEMP
+40 TO +125 °F
1 S/S
1 S/S
CABIN HEAT EXCHANGER
GLYCOL EVAPORATOR
STEAM PRESS
GLY DISCH PRESS
PSIA
ECS INDICATORS
SEC
PRIM
MDC 2
S89
SECONDARY GLYCOL IN
4.4
PRIM ACCUM FILL
ON
OFF
LHEB 379
ECS GLYCOL PUMPS
$V_{AC 1}$
AC 1 ϕA
MDC 4
CB7
AC 1 ϕB
CB8
AC 1 ϕC
CB9
$V_{AC 2}$
AC 2 ϕA
CB10
AC 2 ϕB
CB11
AC 2 ϕC
CB12
ECS GLYCOL PUMPS
OFF
AC1
AC2
MDC 4
S2
WATER CONTROL ACTIVATION SWITCH OPENS WHEN STEAM PRESSURE CONTROL VALVE OPENS TO ALLOW OPERATION OF THE WATER CONTROL SECTION. SWITCH CLOSES WHEN STEAM PRESS. CONTROL VALVE CLOSES TO PREVENT WATER CONTROL SECTION OPERATION.
65% MAX
ENV CONT SYS TRANSDUCER
PRESS. GROUPS 2 MNA
5A
MDC 5
CB34
V_{MA}
PRESS. GROUPS 2 MNB
CB35
V_{MB}
STEAM PRESS CONTROL VALVE
ENV CONT SYS
URINE DUCT HTR
MNA
CB50
MNB
CB51
SEC EVAP
4.4
TO URINE DUMP HTRS
4.5
3W
STEAM DUCT HEATERS
FROM TEMP XDUCER PWR SUPPLY
XDUCER AMP
CF0017T
GLYCOL EVAP OUT STEAM TEMP
+20 TO +95° F
1 S/S
OVERBOARD
OCT 651



3 PRI COOL

SIGNATURES	DATE
OR	
ENG	
CH	
NR	
APP	
AUTH	

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS

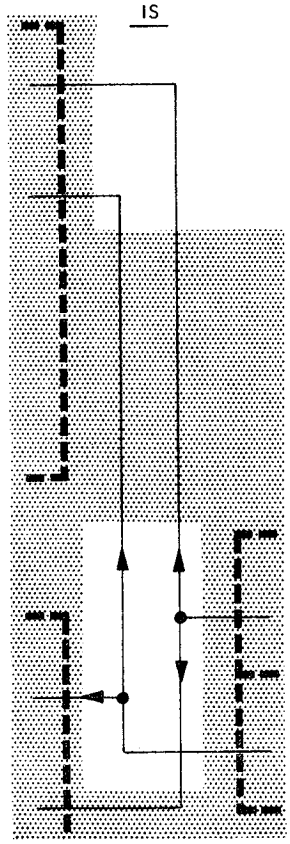
PRIMARY GLYCOL LOOP

CSM 104 | SIZE J | DWG NO. 4.3 | SHEET 1 OF 1

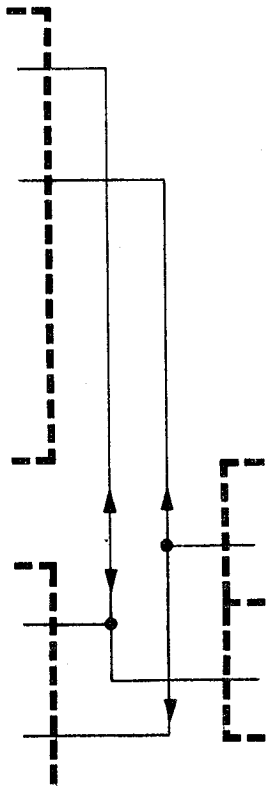
SECTION 4

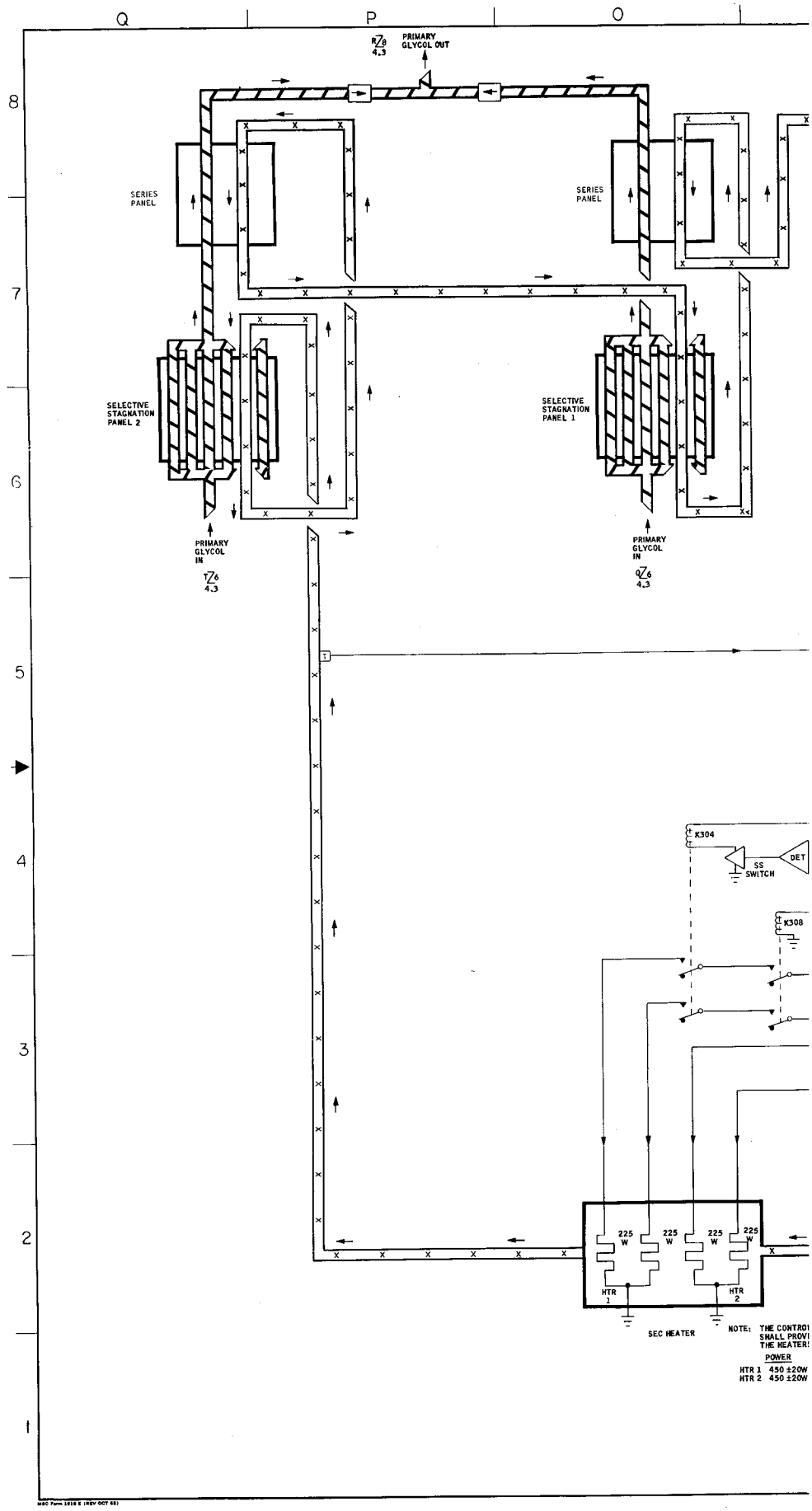
3. DWG 4.3 M,N Z 7,6

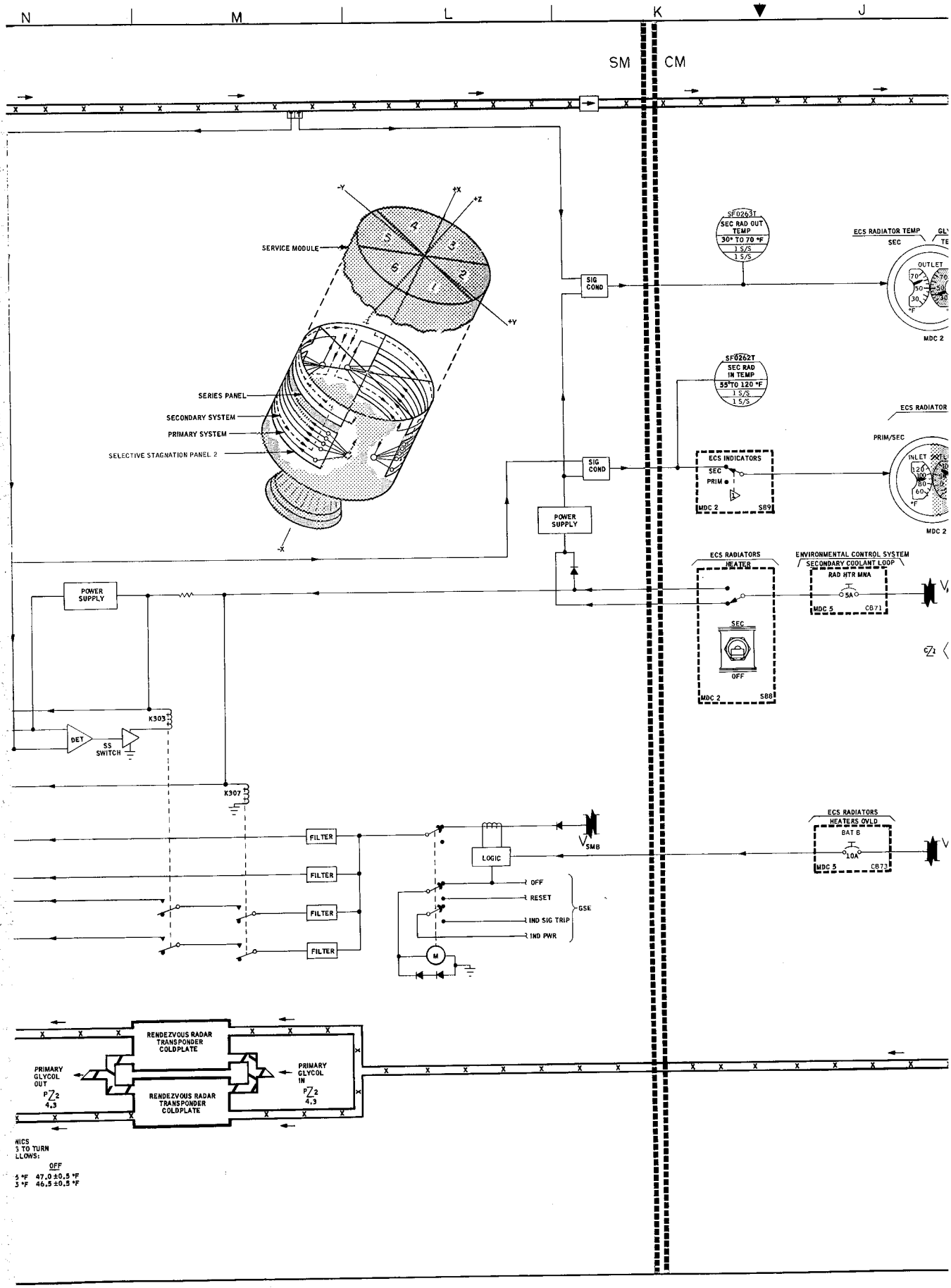
IS

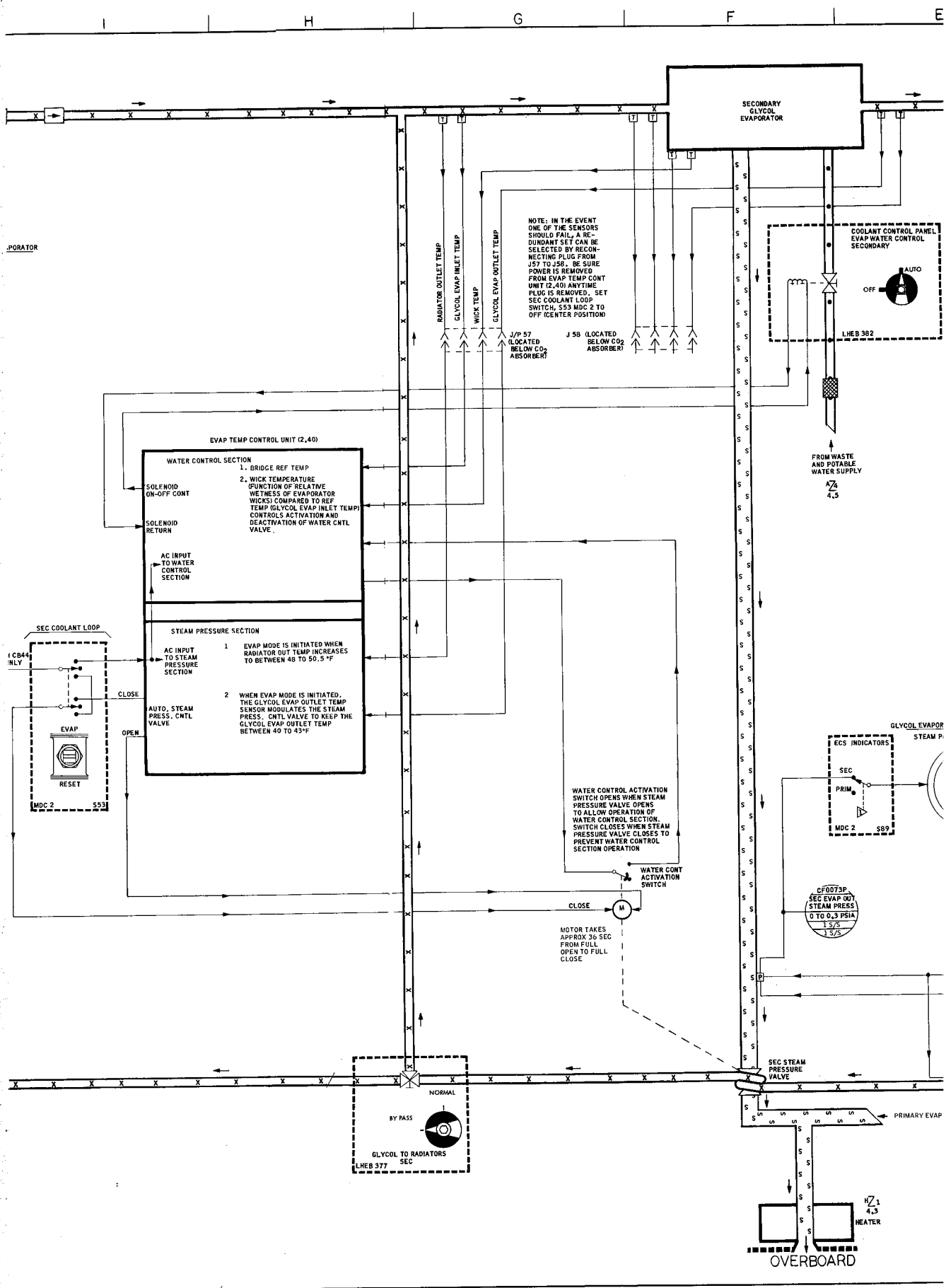


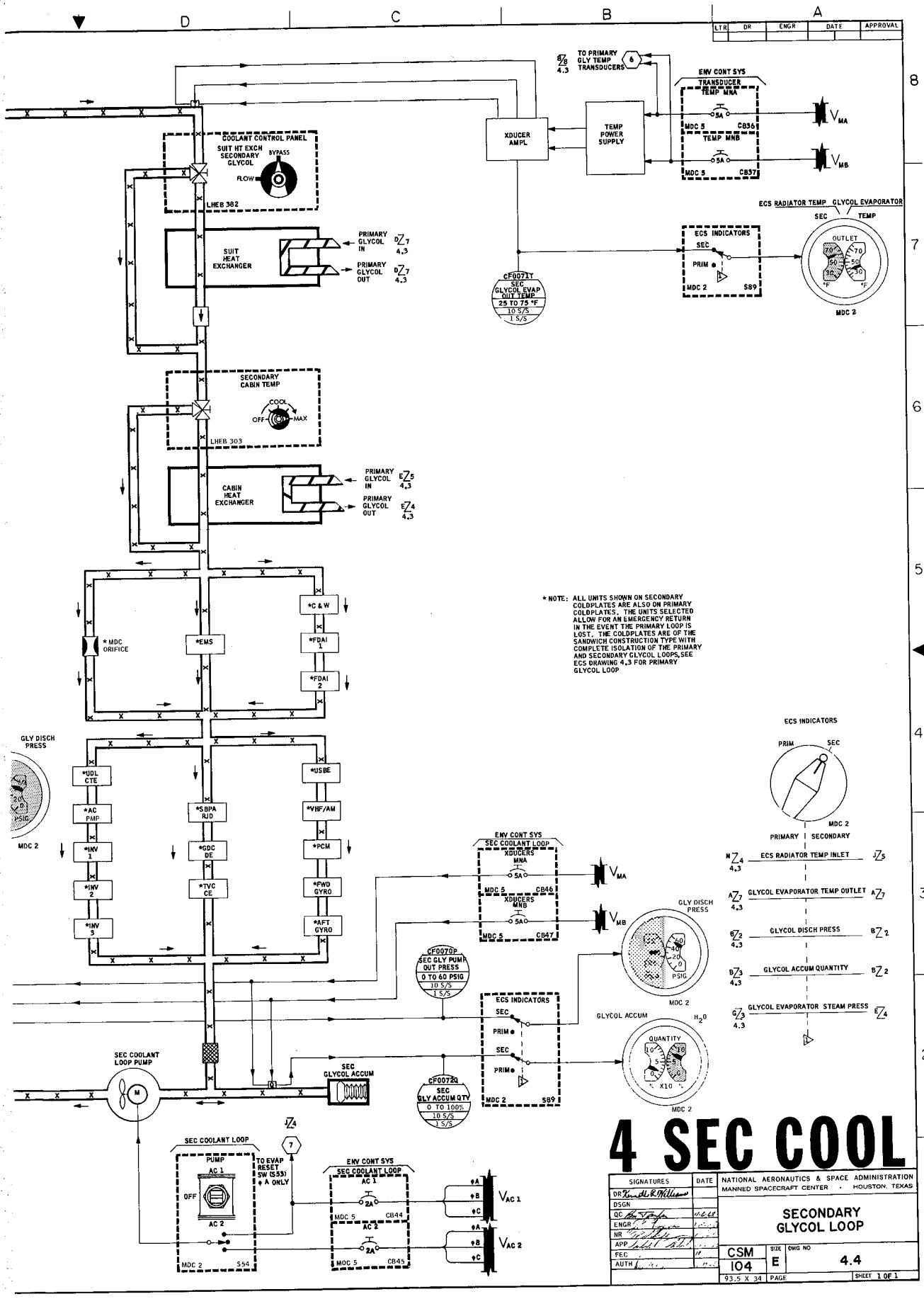
WAS




Q
P
O
8
7
6
5
4
3
2
1
PRIMARY GLYCOL OUT
SERIES PANEL
SERIES PANEL
SELECTIVE STAGNATION PANEL 2
SELECTIVE STAGNATION PANEL 1
PRIMARY GLYCOL IN
PRIMARY GLYCOL IN
K304
SS SWITCH
DET
K308
225 W
225 W
225 W
225 W
HTR 1
HTR 2
SEC HEATER
NOTE: THE CONTRO
SHALL PROVI
THE HEATER
POWER
HTR 1 450 ±20W
HTR 2 450 ±20W


N
M
L
K
J
SM
CM
SERVICE MODULE
SERIES PANEL
SECONDARY SYSTEM
PRIMARY SYSTEM
SELECTIVE STAGNATION PANEL 2
+X
+Y
+Z
-X
-Y
SIG COND
SF0263T
SEC RAD OUT TEMP
30° TO 70 °F
1 S/S
1 S/S
ECS RADIATOR TEMP
SEC
OUTLET
MDC 2
SF0262T
SEC RAD IN TEMP
55° TO 120 °F
1 S/S
1 S/S
ECS RADIATOR
PRIM/SEC
INLET
ECS INDICATORS
SEC
PRIM
MDC 2
S89
POWER SUPPLY
ECS RADIATORS
HEATER
SEC
OFF
MDC 2
S88
ENVIRONMENTAL CONTROL SYSTEM
SECONDARY COOLANT LOOP
RAD HTR MNA
5A
MDC 5
CB71
K303
DET
SS SWITCH
K307
FILTER
FILTER
FILTER
FILTER
LOGIC
VSMB
OFF
RESET
IND SIG TRIP
IND PWR
GSE
M
ECS RADIATORS
HEATERS OVLD
BAT B
10A
MDC 5
CB73
RENDEZVOUS RADAR TRANSPONDER COLDPLATE
RENDEZVOUS RADAR TRANSPONDER COLDPLATE
PRIMARY GLYCOL OUT
PRIMARY GLYCOL IN
P 2 4,3
P 2 4,3
NICS
S TO TURN
LLOWS:
OFF
°F 47.0 ±0.5 °F
°F 46.5 ±0.5 °F


I
H
G
F
E
SECONDARY GLYCOL EVAPORATOR
RADIATOR OUTLET TEMP
GLYCOL EVAP INLET TEMP
WICK TEMP
GLYCOL EVAP OUTLET TEMP
NOTE: IN THE EVENT ONE OF THE SENSORS SHOULD FAIL, A REDUNDANT SET CAN BE SELECTED BY RECONNECTING PLUG FROM J57 TO J58. BE SURE POWER IS REMOVED FROM EVAP TEMP CONT UNIT (2,40) ANYTIME PLUG IS REMOVED. SET SEC COOLANT LOOP SWITCH, S53 MDC 2 TO OFF (CENTER POSITION)
J/P 57 (LOCATED BELOW CO_2 ABSORBER)
J 58 (LOCATED BELOW CO_2 ABSORBER)
COOLANT CONTROL PANEL EVAP WATER CONTROL SECONDARY
AUTO
OFF
LHEB 382
FROM WASTE AND POTABLE WATER SUPPLY
EVAP TEMP CONTROL UNIT (2,40)
WATER CONTROL SECTION
1. BRIDGE REF TEMP
2. WICK TEMPERATURE (FUNCTION OF RELATIVE WETNESS OF EVAPORATOR WICKS) COMPARED TO REF TEMP (GLYCOL EVAP INLET TEMP) CONTROLS ACTIVATION AND DEACTIVATION OF WATER CNTL VALVE.
SOLENOID ON-OFF CONT
SOLENOID RETURN
AC INPUT TO WATER CONTROL SECTION
STEAM PRESSURE SECTION
AC INPUT TO STEAM PRESSURE SECTION
1 EVAP MODE IS INITIATED WHEN RADIATOR OUT TEMP INCREASES TO BETWEEN 48 TO 50.5 °F
2 WHEN EVAP MODE IS INITIATED, THE GLYCOL EVAP OUTLET TEMP SENSOR MODULATES THE STEAM PRESS. CNTL VALVE TO KEEP THE GLYCOL EVAP OUTLET TEMP BETWEEN 40 TO 43°F
AUTO. STEAM PRESS. CNTL VALVE
SEC COOLANT LOOP
CLOSE
OPEN
EVAP
RESET
MDC 2
S53
WATER CONTROL ACTIVATION SWITCH OPENS WHEN STEAM PRESSURE VALVE OPENS TO ALLOW OPERATION OF WATER CONTROL SECTION. SWITCH CLOSES WHEN STEAM PRESSURE VALVE CLOSES TO PREVENT WATER CONTROL SECTION OPERATION
WATER CONT ACTIVATION SWITCH
CLOSE
M
MOTOR TAKES APPROX 36 SEC FROM FULL OPEN TO FULL CLOSE
ECS INDICATORS
SEC
PRIM
MDC 2
S89
CF0073P
SEC EVAP OUT STEAM PRESS
0 TO 0.3 PSIA
1 S/S
1 S/S
SEC STEAM PRESSURE VALVE
NORMAL
BY PASS
GLYCOL TO RADIATORS SEC
LHEB 377
PRIMARY EVAP
HEATER
OVERBOARD



4 SEC COOL

SIGNATURES	DATE
ORIG R. R. Williams	
DSGN	
QC	
ENGR	
NR	
APP	
FEC	
AUTH	

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
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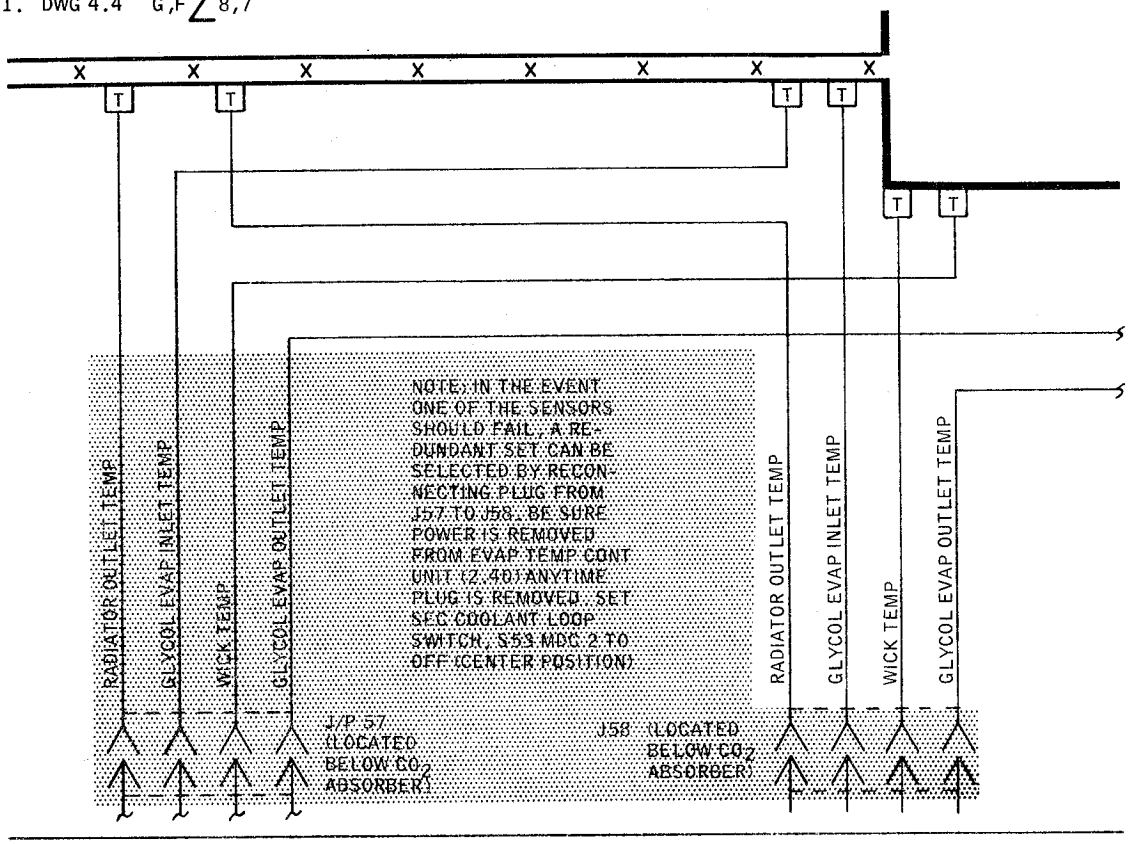
SECONDARY GLYCOL LOOP

CSM	SIZE	DWG NO	
104	E	4.4	
93.5 X 34	PAGE	SHEET 1 OF 1	

1. DWG 4.4 G,F Z 8,7

IS



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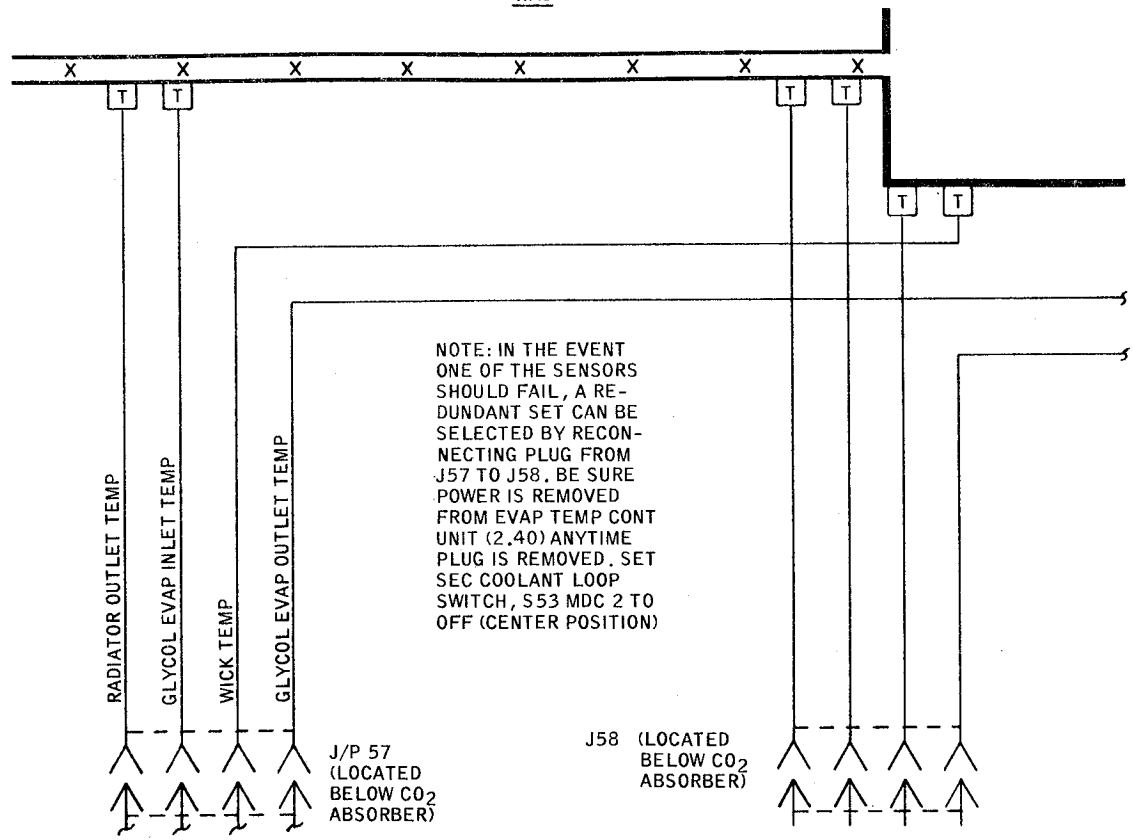
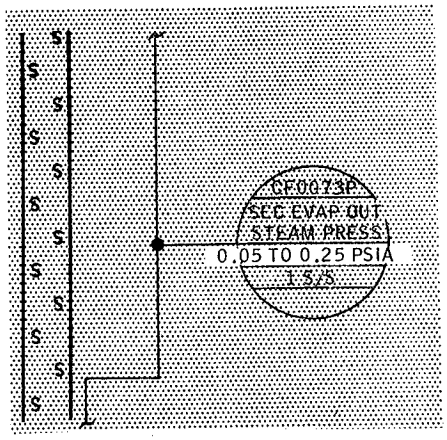
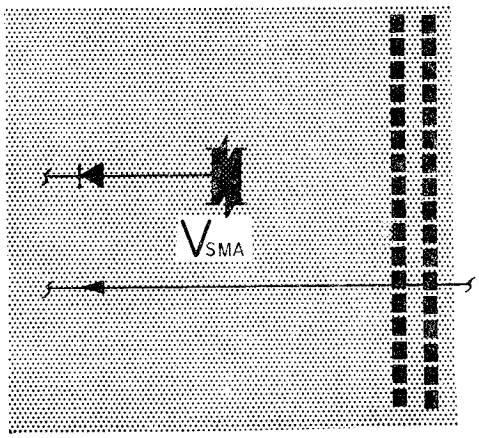


IS

2. DWG 4.4 F Z 3



3. DWG 4.4 K Z 3



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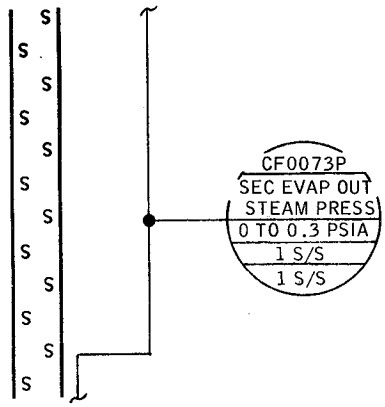
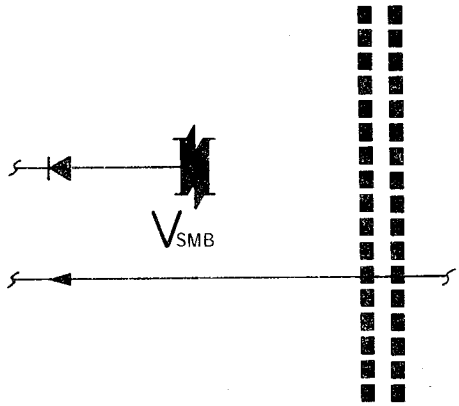
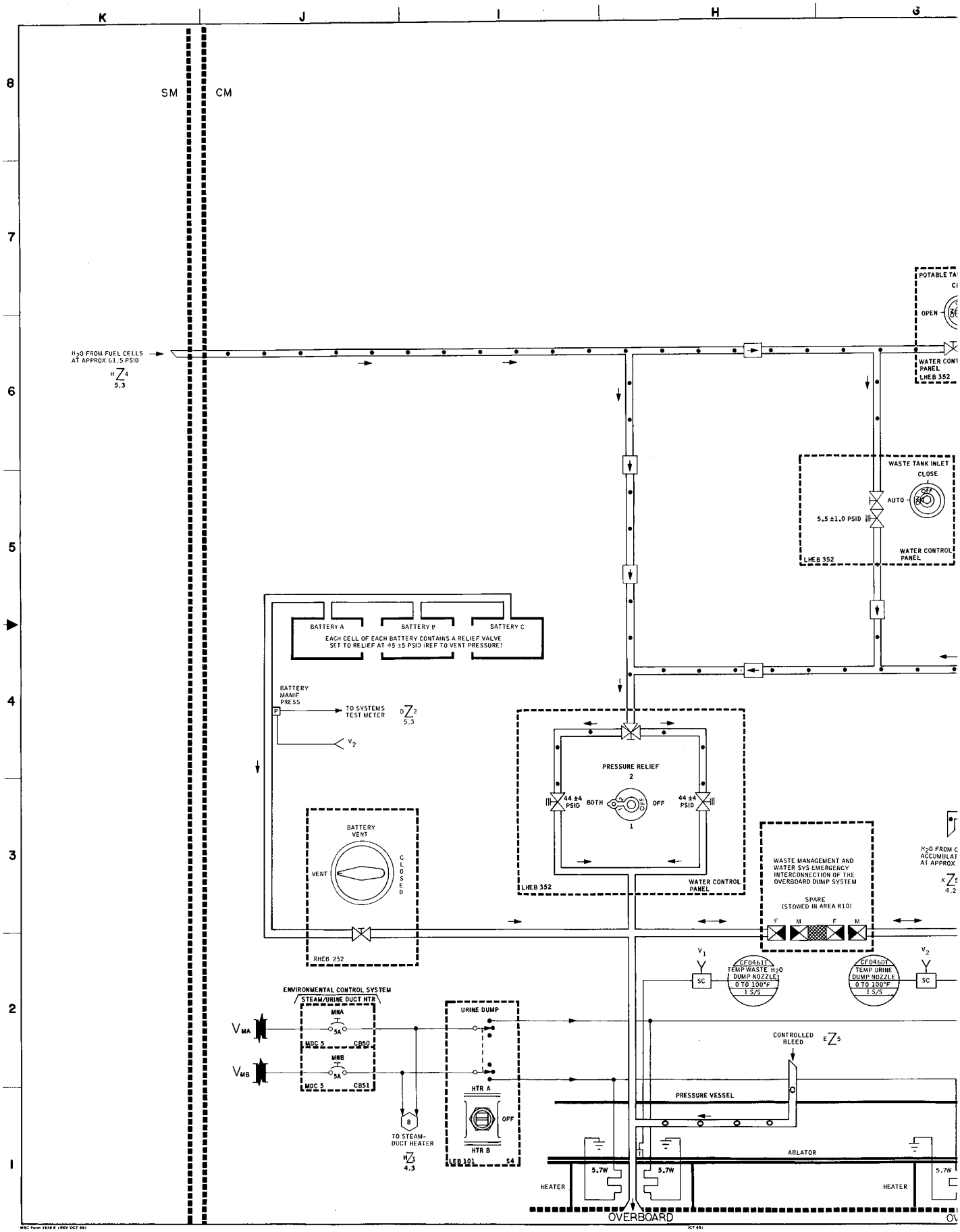
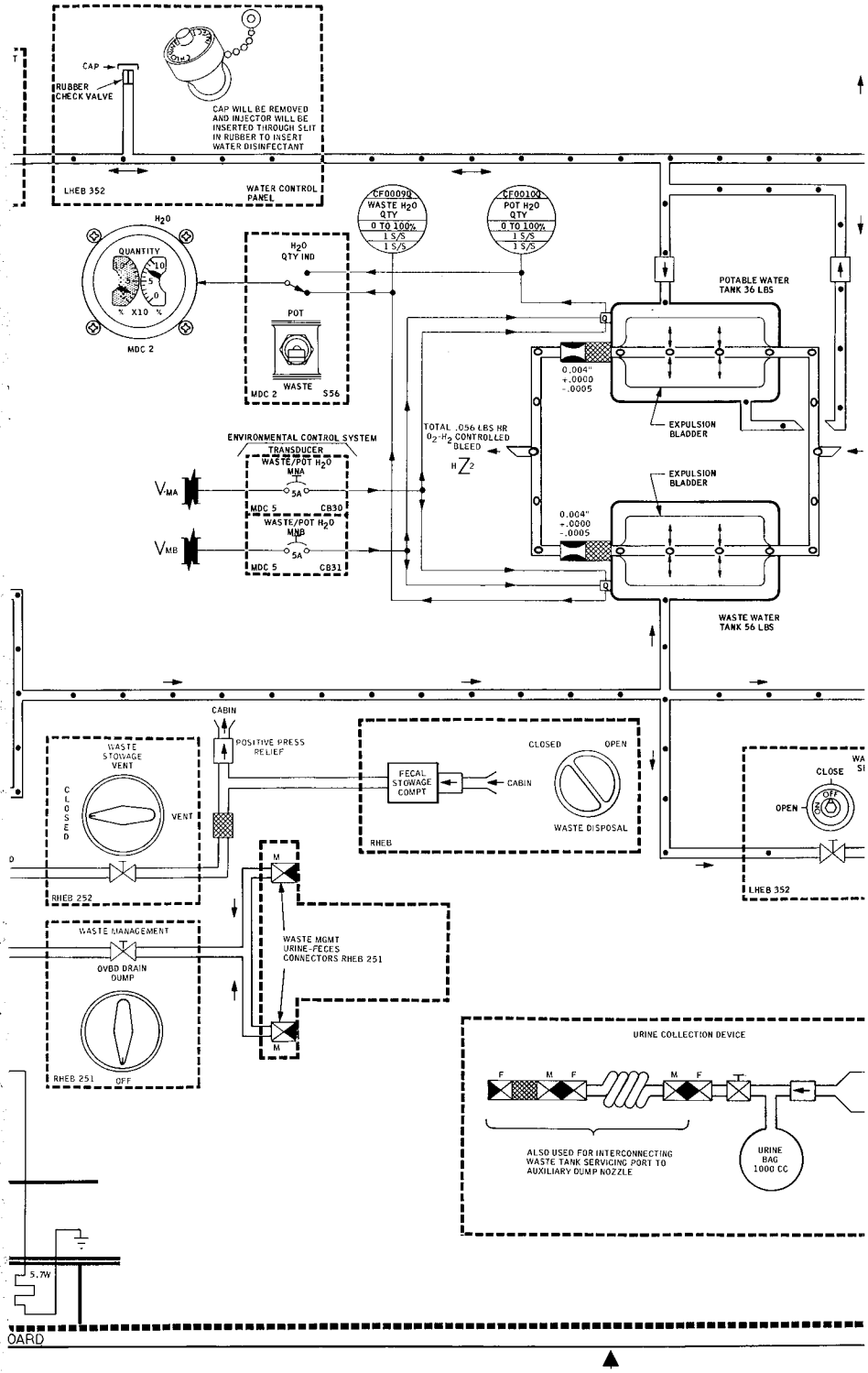
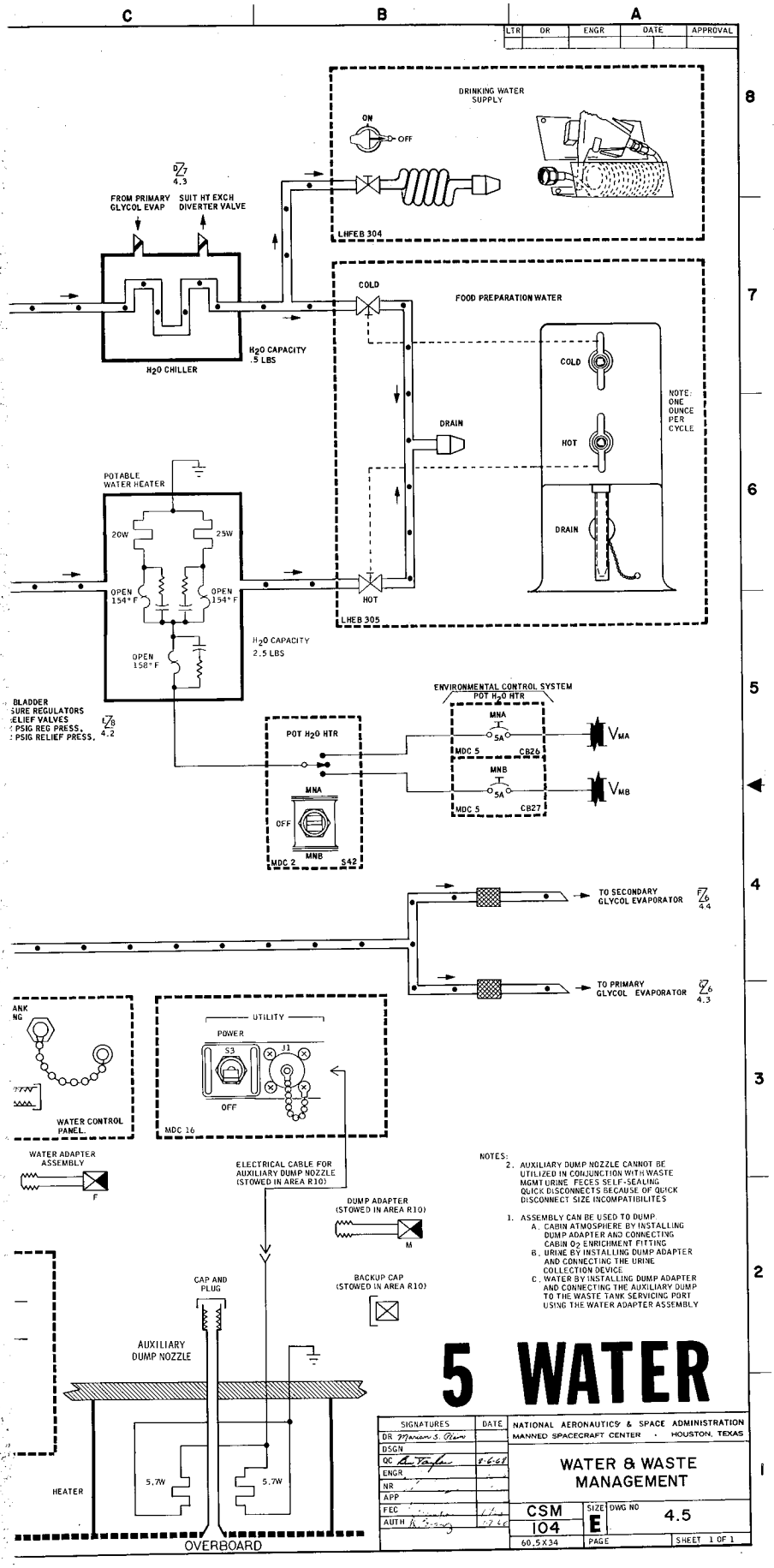





K
J
I
H
G
8
7
6
5
4
3
2
1
SM
CM
H2O FROM FUEL CELLS AT APPROX 61.5 PSID
H Z4 5.3
POTABLE TA
CI
OPEN
WATER CONT PANEL LHEB 352
WASTE TANK INLET
CLOSE
AUTO
5.5 ±1.0 PSID
LHEB 352
WATER CONTROL PANEL
BATTERY A
BATTERY B
BATTERY C
EACH CELL OF EACH BATTERY CONTAINS A RELIEF VALVE SET TO RELIEF AT 45 ±5 PSID (REF TO VENT PRESSURE)
BATTERY MANIF PRESS
TO SYSTEMS TEST METER
D Z2 5.3
V2
PRESSURE RELIEF
2
44 ±4 PSID
BOTH
OFF
44 ±4 PSID
1
LHEB 352
WATER CONTROL PANEL
BATTERY VENT
VENT
CLOSED
RHEB 252
WASTE MANAGEMENT AND WATER SYS EMERGENCY INTERCONNECTION OF THE OVERBOARD DUMP SYSTEM
SPARE (STOWED IN AREA R10)
F
M
F
M
H2O FROM C ACCUMULAT AT APPROX
K Z5 4.2
V1
SC
CF04611
TEMP WASTE H2O DUMP NOZZLE
0 TO 100°F
1 S/S
CF04601
TEMP URINE DUMP NOZZLE
0 TO 100°F
1 S/S
V2
SC
ENVIRONMENTAL CONTROL SYSTEM
STEAM/URINE DUCT HTR
MHA
5A
MDC 5
CB50
MHB
5A
MDC 5
CB51
VMA
VMB
URINE DUMP
HTR A
OFF
HTR B
LEB 101
S4
B
TO STEAM-DUCT HEATER
H Z1 4.3
CONTROLLED BLEED
E Z5
PRESSURE VESSEL
ABLATOR
5.7W
5.7W
5.7W
HEATER
HEATER
OVERBOARD
OV

F E D

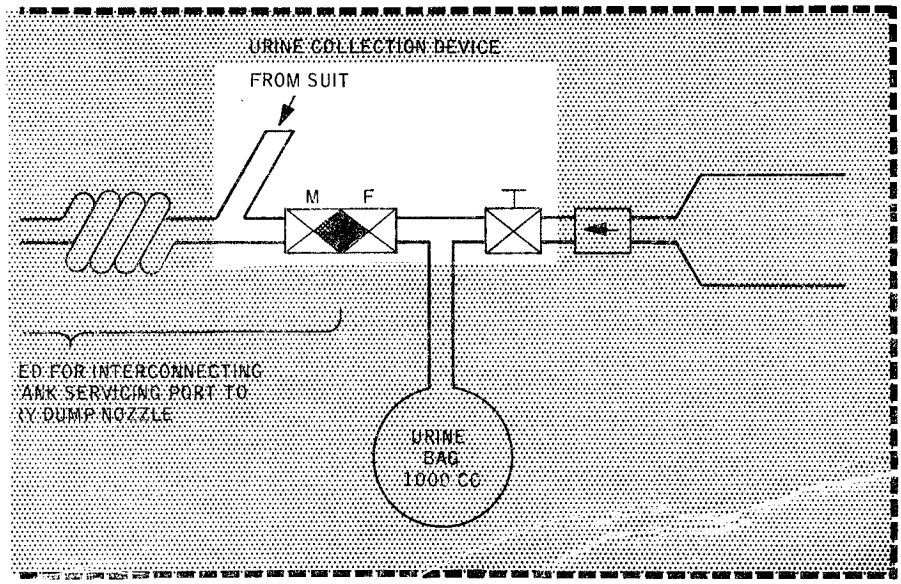

CAP
RUBBER CHECK VALVE
CAP WILL BE REMOVED AND INJECTOR WILL BE INSERTED THROUGH SLIT IN RUBBER TO INSERT WATER DISINFECTANT
LHEB 352
WATER CONTROL PANEL
CF00098 WASTE H2O QTY 0 TO 100% 1 S/S 1 S/S
CF00104 POT H2O QTY 0 TO 100% 1 S/S 1 S/S
H2O
QUANTITY
MDC 2
H2O QTY IND
POT
WASTE
MDC 2 S56
POTABLE WATER TANK 36 LBS
0.004" +.0000 -.0005
EXPULSION BLADDER
TOTAL .056 LBS HR O2-H2 CONTROLLED BLEED
ENVIRONMENTAL CONTROL SYSTEM
TRANSDUCER
WASTE/POT H2O MNA
5A
MDC 5 CB30
WASTE/POT H2O MNB
5A
MDC 5 CB31
VMA
VMB
WASTE WATER TANK 56 LBS
CABIN
POSITIVE PRESS RELIEF
WASTE STOWAGE VENT
CLOSED
VENT
RHEB 252
FECAL STOWAGE COMPT
CABIN
CLOSED
OPEN
WASTE DISPOSAL
RHEB
CLOSE
OPEN
LHEB 352
M
WASTE MGMT URINE-FECES CONNECTORS RHEB 251
WASTE MANAGEMENT
OVBD DRAIN DUMP
RHEB 251 OFF
URINE COLLECTION DEVICE
F M F M F
ALSO USED FOR INTERCONNECTING WASTE TANK SERVICING PORT TO AUXILIARY DUMP NOZZLE
URINE BAG 1000 CC
5.7W
OARD


C
B
A
LTR
DR
ENGR
DATE
APPROVAL
DRINKING WATER SUPPLY
ON
OFF
LHFEB 304
FROM PRIMARY GLYCOL EVAP
SUIT HT EXCH DIVERTER VALVE
H2O CHILLER
H2O CAPACITY .5 LBS
FOOD PREPARATION WATER
COLD
HOT
DRAIN
NOTE: ONE OUNCE PER CYCLE
LHEB 305
POTABLE WATER HEATER
20W
25W
OPEN 154°F
OPEN 154°F
OPEN 158°F
H2O CAPACITY 2.5 LBS
BLADDER
SURE REGULATORS
ELIEF VALVES
PSIG REG PRESS,
PSIG RELIEF PRESS,
ENVIRONMENTAL CONTROL SYSTEM
POT H2O HTR
MNA
5A
MDC 5
CB26
MNB
CB27
VMA
VMB
POT H2O HTR
OFF
MDC 2
S42
TO SECONDARY GLYCOL EVAPORATOR
TO PRIMARY GLYCOL EVAPORATOR
ANK
NG
WATER CONTROL PANEL.
UTILITY
POWER
S3
J1
OFF
MDC 16
WATER ADAPTER ASSEMBLY
F
ELECTRICAL CABLE FOR AUXILIARY DUMP NOZZLE (STOWED IN AREA R10)
DUMP ADAPTER (STOWED IN AREA R10)
M
BACKUP CAP (STOWED IN AREA R10)
CAP AND PLUG
AUXILIARY DUMP NOZZLE
HEATER
5.7W
5.7W
OVERBOARD
NOTES:
2. AUXILIARY DUMP NOZZLE CANNOT BE UTILIZED IN CONJUNCTION WITH WASTE MGMT URINE FECES SELF-SEALING QUICK DISCONNECTS BECAUSE OF QUICK DISCONNECT SIZE INCOMPATIBILITES
1. ASSEMBLY CAN BE USED TO DUMP:
A. CABIN ATMOSPHERE BY INSTALLING DUMP ADAPTER AND CONNECTING CABIN O2 ENRICHMENT FITTING
B. URINE BY INSTALLING DUMP ADAPTER AND CONNECTING THE URINE COLLECTION DEVICE
C. WATER BY INSTALLING DUMP ADAPTER AND CONNECTING THE AUXILIARY DUMP TO THE WASTE TANK SERVICING PORT USING THE WATER ADAPTER ASSEMBLY
5 WATER
SIGNATURES
DATE
DR Marvin S. Rice
DSGN
QC A. Taylor 8-6-68
ENGR
NR
APP
FEC
AUTH
NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS
WATER & WASTE MANAGEMENT
CSM 104
SIZE E
DWG NO 4.5
60.5X34
PAGE
SHEET 1 OF 1

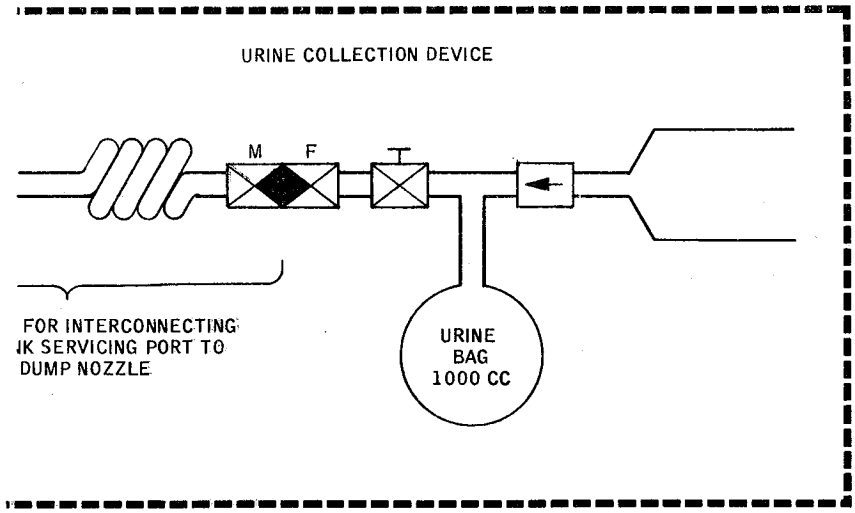
SECTION 4

IS

1. DWG 4.5 D Z 2



WAS



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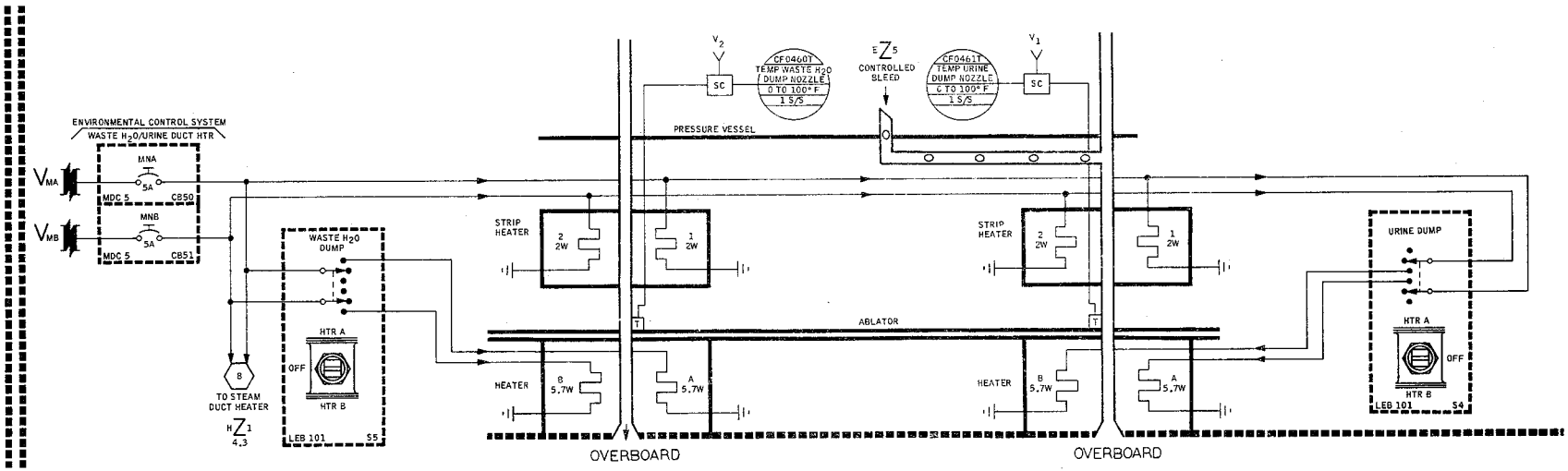

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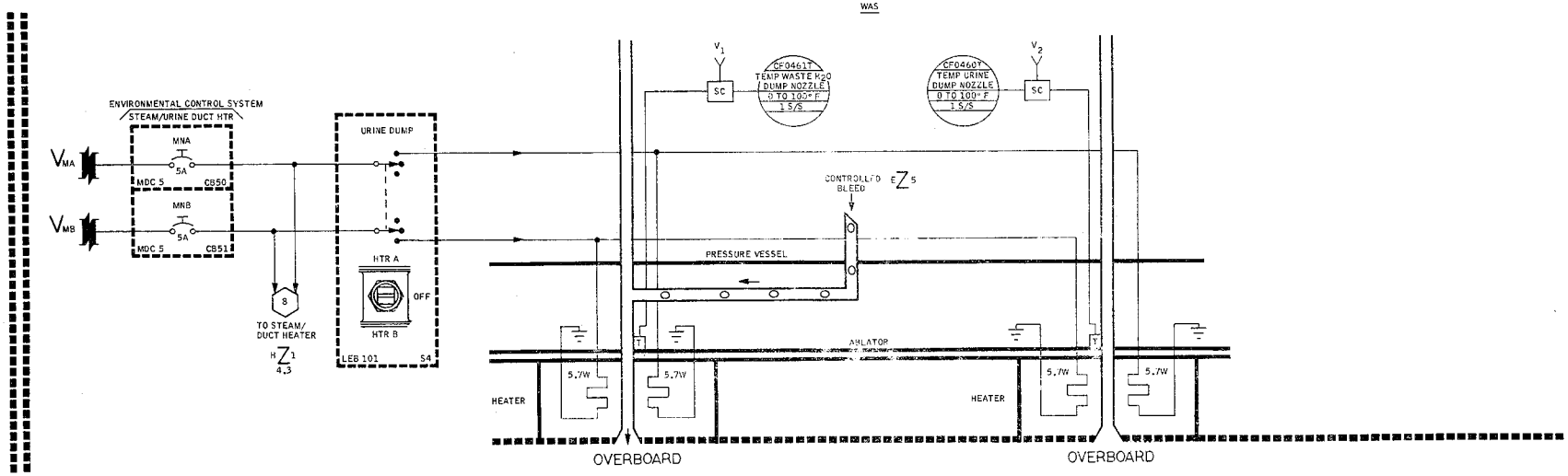
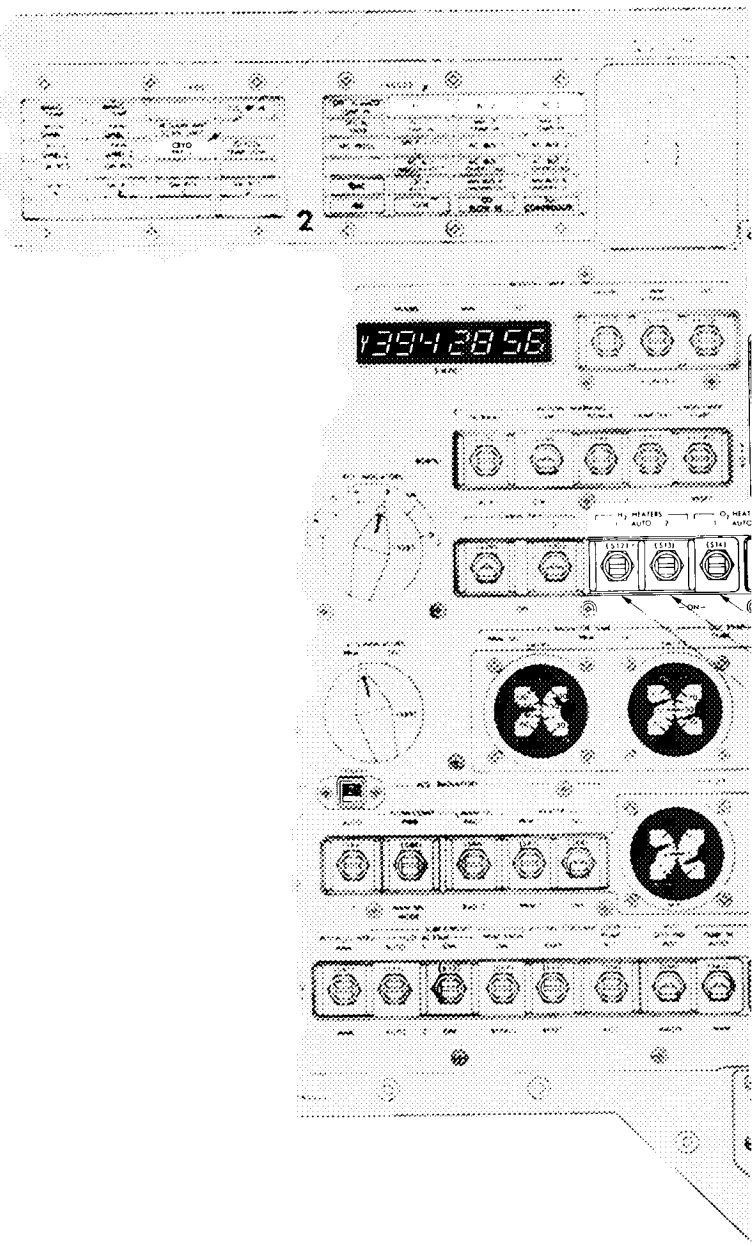
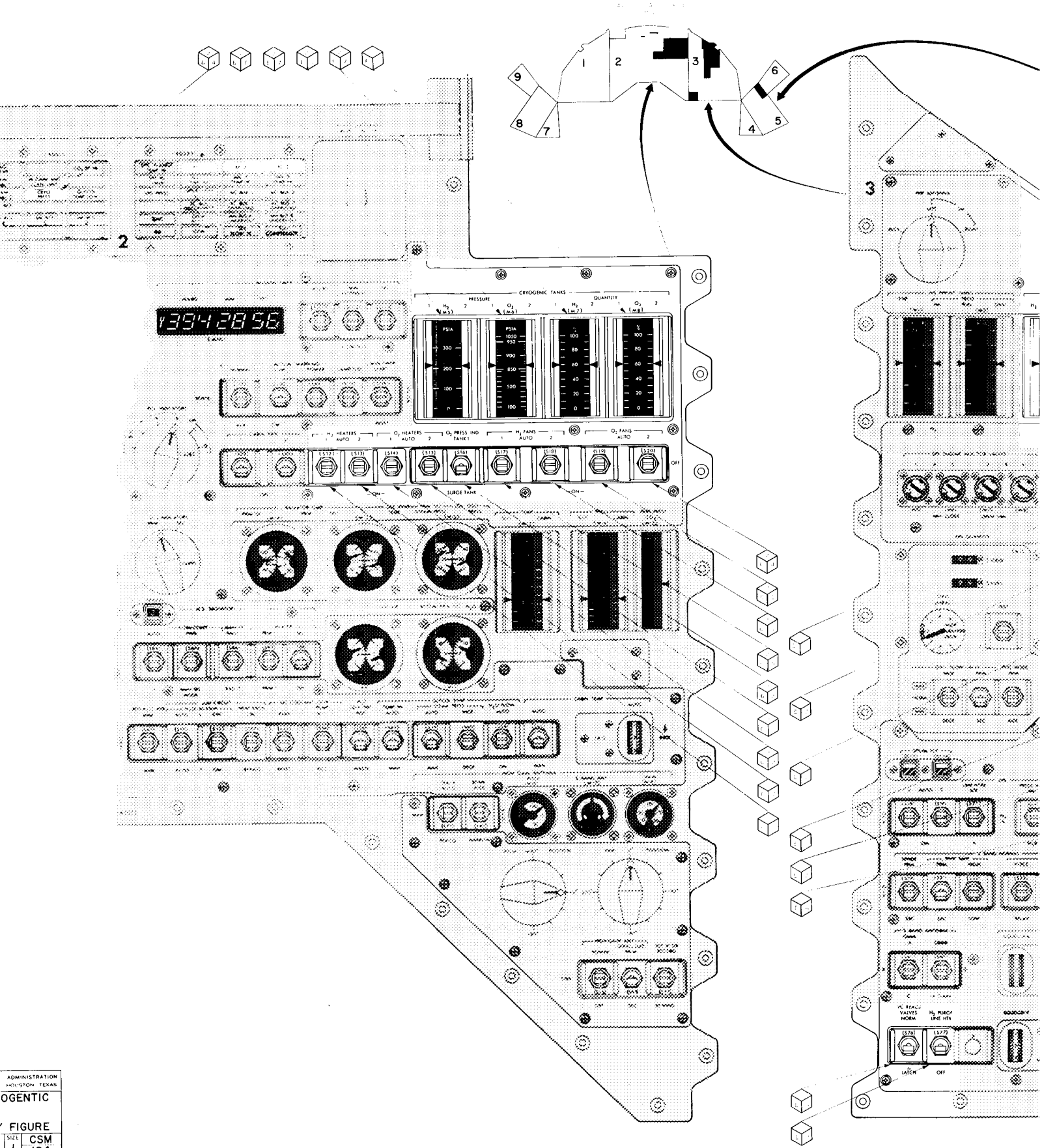


2. DWG 4.5 J,H,G,F Z2,1

5 FUEL CELL/
CRYOGENICS
SYSTEM



NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER — HOUSTON, TEXAS		
FUEL CELL / CRYOGENTIC SYSTEM CONTROL-DISPLAY FIGURE		
DWG NO. FIG 5.1	SIZE J	CSM 104
SHEET OF	PAGE	SCALE



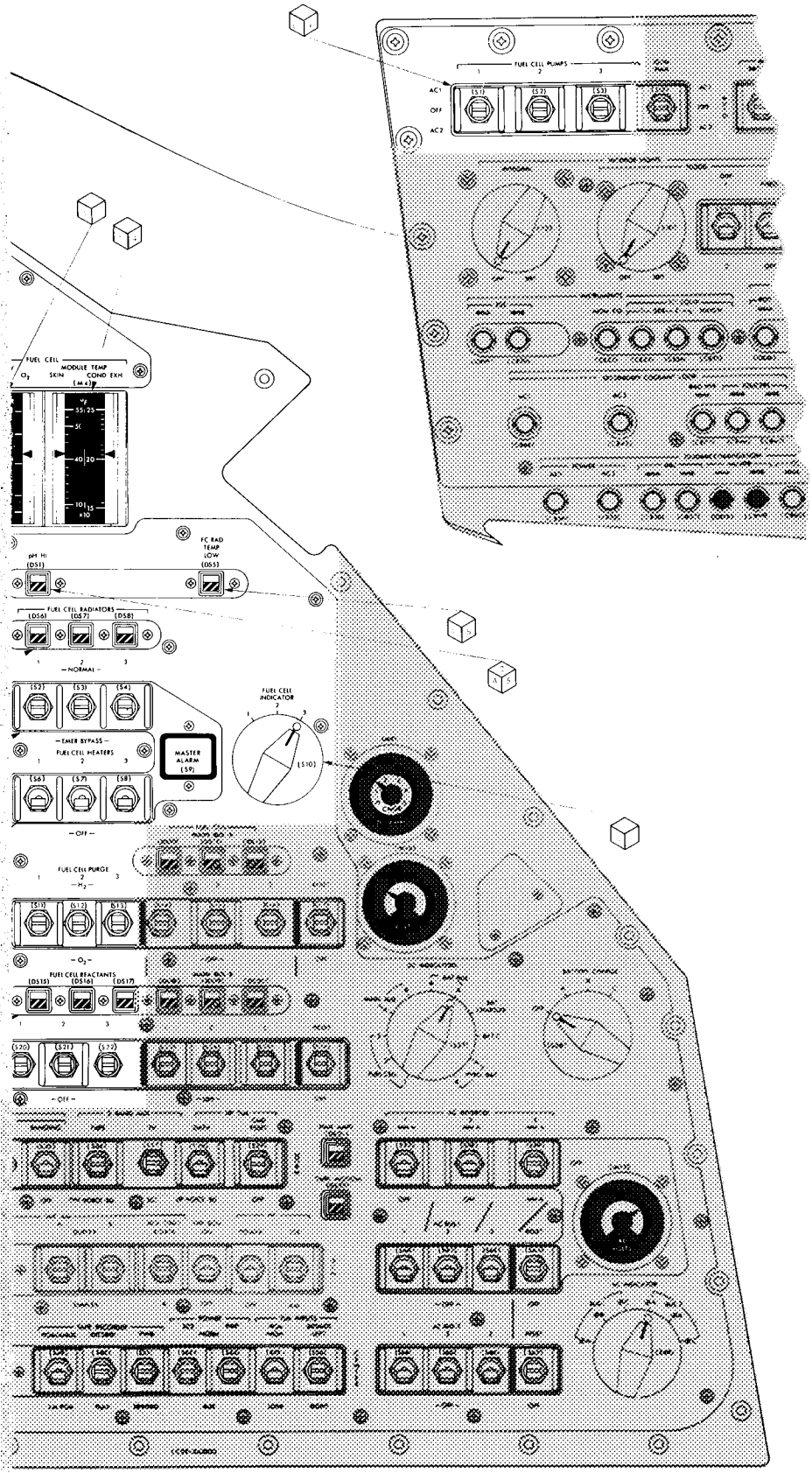
ADMINISTRATION
HOUSTON TEXAS

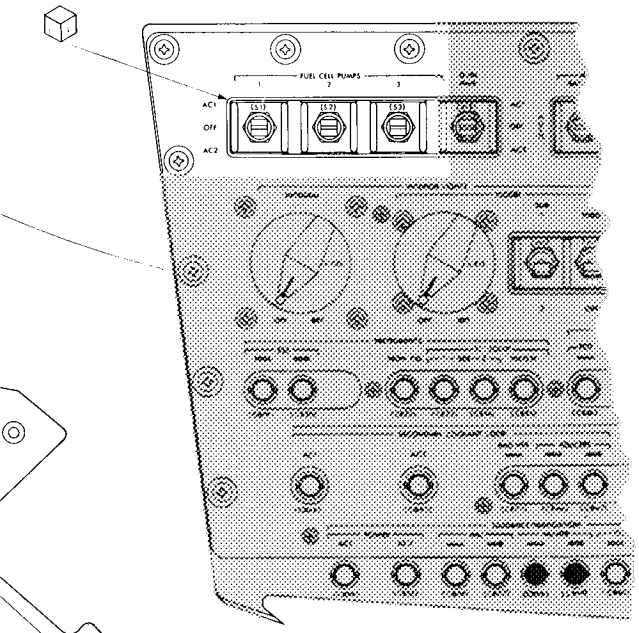
OGENTIC

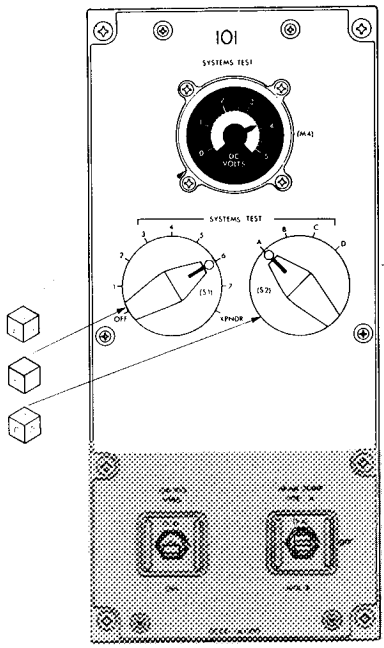
FIGURE

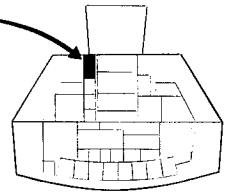
SIZE J | CSM 104

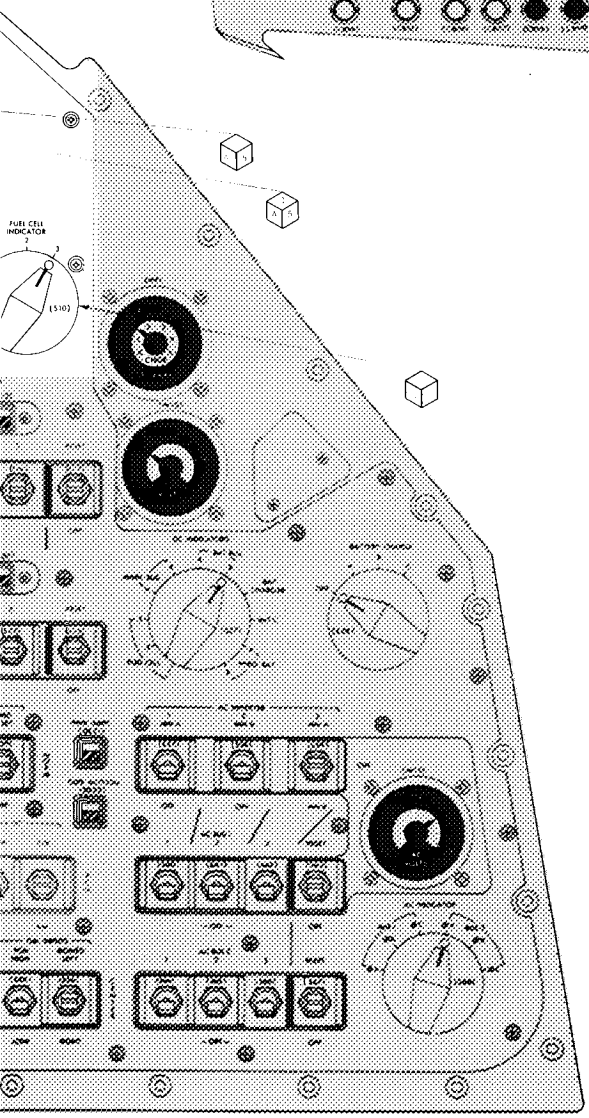
SCALE

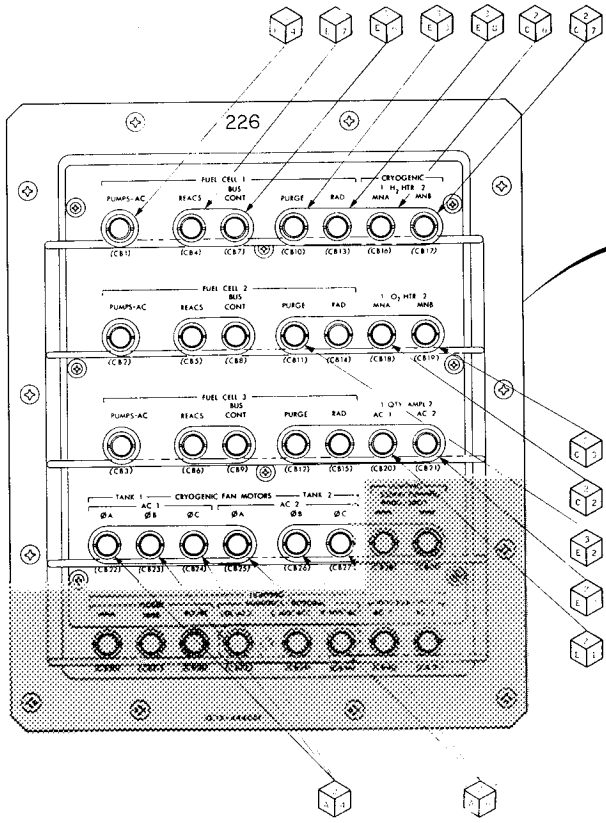

FUEL CELL PUMPS
AC1
OFF
AC2
FUEL CELL
MODULE TEMP
SKIN
COND EXH
FC RAD TEMP LOW
FUEL CELL RADIATORS
NORMAL
EMER BYPASS
FUEL CELL HEATERS
OFF
MASTER ALARM
FUEL CELL INDICATOR
FUEL CELL PURGE
FUEL CELL REACTANTS

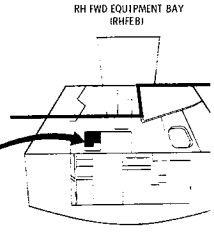

FUEL CELL PUMPS
AC1
OFF
AC2
(S1)
(S2)
(S3)

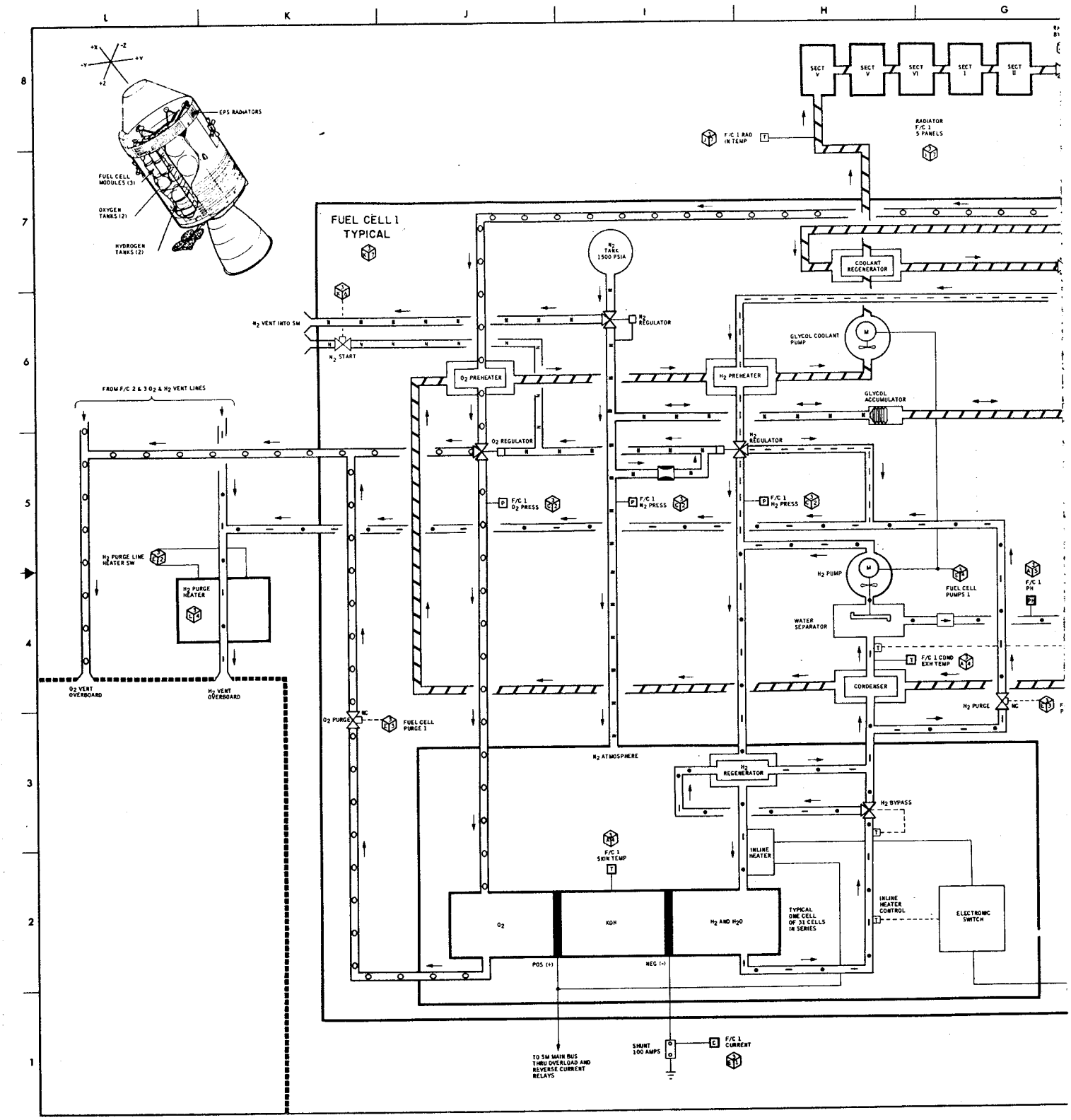

101
SYSTEMS TEST
SYSTEMS TEST
OFF
(S1)
(S2)

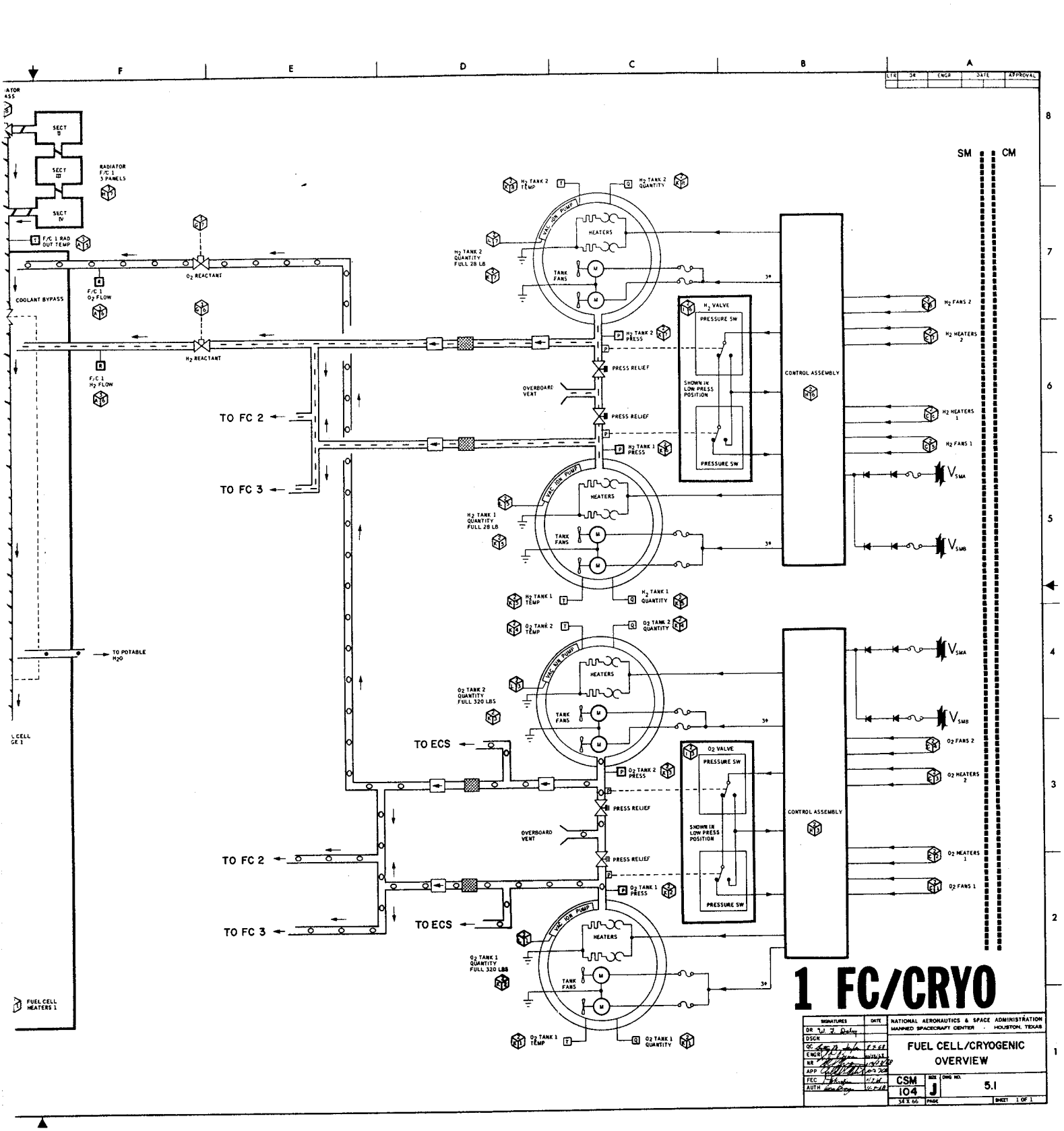

LOWER EQUIPMENT BAY
(LEB)


FUEL CELL
INDICATOR
(S10)


226
FUEL CELL 1
PUMPS-AC
REACS
BUS CONT
PURGE
RAD
CRYOGENIC
1 H2 HTR 2
MNA
MNB
FUEL CELL 2
FUEL CELL 3
TANK 1
CRYOGENIC FAN MOTORS
TANK 2
AC 1
AC 2


RH FWD EQUIPMENT BAY
(RHFEB)
RH EQUIPMENT BAY
(RHEB)


EPS RADIATORS
FUEL CELL MODULES (3)
OXYGEN TANKS (2)
HYDROGEN TANKS (2)
FUEL CELL 1 TYPICAL
SECT V
SECT V
SECT VI
SECT I
SECT II
RADIATOR F/C 1 5 PANELS
F/C 1 RAD IN TEMP
COOLANT REGENERATOR
N_2 TANK 1500 PSIA
N_2 REGULATOR
N_2 VENT INTO SM
N_2 START
GLYCOL COOLANT PUMP
O_2 PREHEATER
H_2 PREHEATER
GLYCOL ACCUMULATOR
FROM F/C 2 & 3 O_2 & H_2 VENT LINES
O_2 REGULATOR
H_2 REGULATOR
F/C 1 O_2 PRESS
F/C 1 H_2 PRESS
F/C 1 H_2 PRESS
H_2 PURGE LINE HEATER SW
H_2 PURGE HEATER
H_2 PUMP
FUEL CELL PUMPS 1
F/C 1 PH
WATER SEPARATOR
F/C 1 COND EXH TEMP
CONDENSER
O_2 VENT OVERBOARD
H_2 VENT OVERBOARD
O_2 PURGE
FUEL CELL PURGE 1
H_2 PURGE
H_2 ATMOSPHERE
H_2 REGENERATOR
H_2 BYPASS
F/C 3 SKIN TEMP
INLINE HEATER
O_2
KOH
H_2 AND H_2O
TYPICAL ONE CELL OF 31 CELLS IN SERIES
INLINE HEATER CONTROL
ELECTRONIC SWITCH
POS (+)
NEG (-)
TO SM MAIN BUS THRU OVERLOAD AND REVERSE CURRENT RELAYS
SHUNT 100 AMPS
F/C 1 CURRENT



1 FC/CRYO

SIGNATURES	DATE
DR W. J. Dailey	
DSGN	
DC	4-2-68
ENGR	4/2/68
NR	4/2/68
APP	4-2-68
FEC	4/2/68
AUTH	4-2-68

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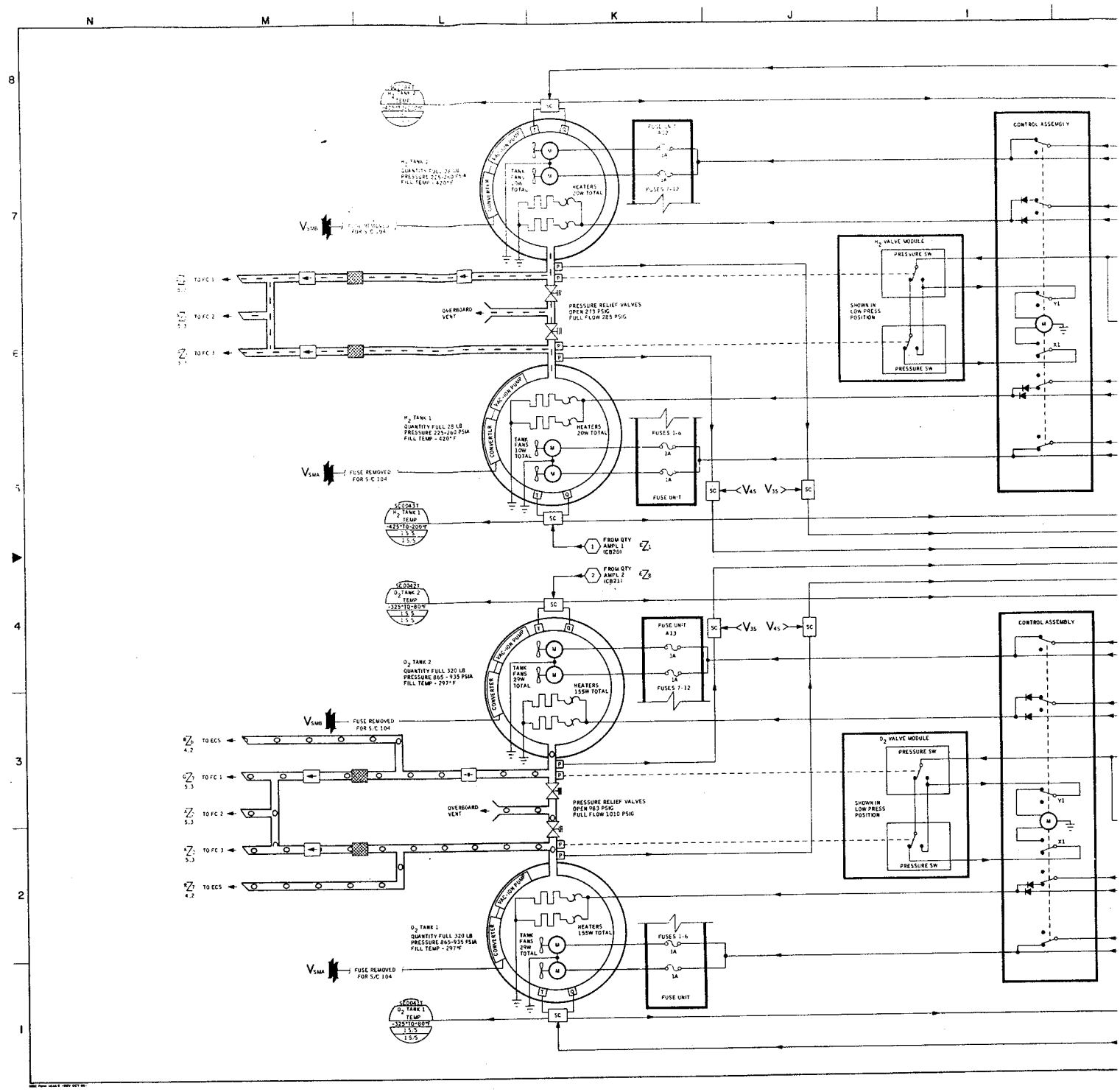
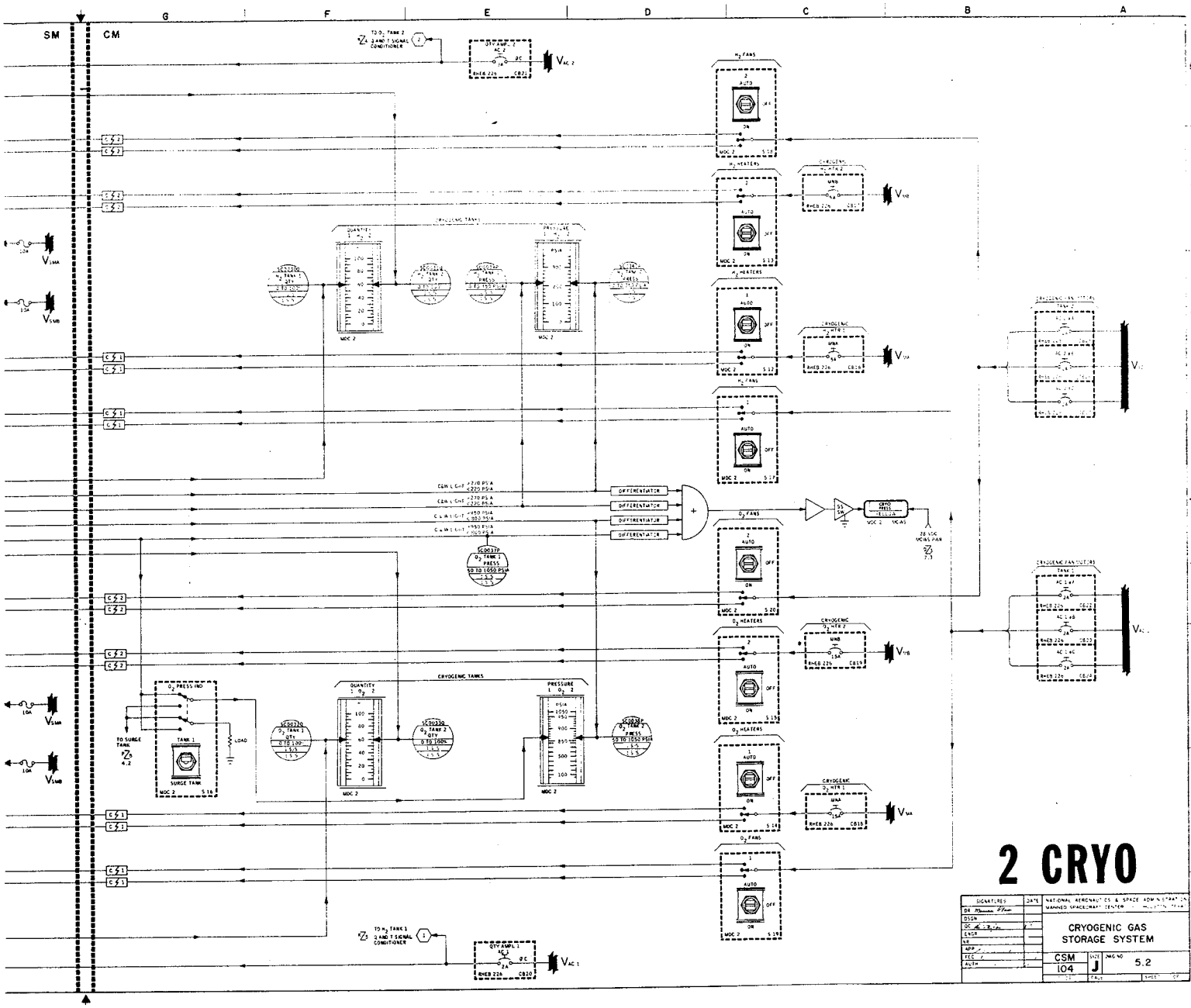
MANNED SPACECRAFT CENTER - HOUSTON, TEXAS

FUEL CELL/CRYOGENIC OVERVIEW

CSM	SIZE	ORIG NO.
104	J	5.1

34 X 66 PAGE SHEET 1 OF 1


N
M
L
K
J
I
8
7
6
5
4
3
2
1
CONTROL ASSEMBLY
H_2 VALVE MODULE
PRESSURE SW
SHOWN IN LOW PRESS POSITION
PRESSURE SW
Y1
X1
H_2 TANK 2
QUANTITY FULL 28 LB
PRESSURE 225-260 PSIA
FILL TEMP - 420°F
HEATERS 20W TOTAL
TANK FANS 10W TOTAL
CONVERTER
RECIRCULATION PUMP
FUSES 1-12
1A
V_{SMB}
FUSE REMOVED FOR S/C 104
TO FC 1
TO FC 2
TO FC 3
OVERBOARD VENT
PRESSURE RELIEF VALVES OPEN 273 PSIG FULL FLOW 285 PSIG
H_2 TANK 1
QUANTITY FULL 28 LB
PRESSURE 225-260 PSIA
FILL TEMP - 420°F
FUSES 1-6
FUSE UNIT
V_{SMA}
SC00431 H_2 TANK 1 TEMP -425°TO-200°F
FROM QTY AMPL 1 (CB20)
FROM QTY AMPL 2 (CB21)
SC00421 O_2 TANK 2 TEMP -325°TO-80°F
O_2 TANK 2
QUANTITY FULL 320 LB
PRESSURE 865 - 935 PSIA
FILL TEMP - 297°F
HEATERS 155W TOTAL
TANK FANS 29W TOTAL
FUSE UNIT A13
V_{3S}
V_{4S}
O_2 VALVE MODULE
SHOWN IN LOW PRESS POSITION
TO ECS
O_2 TANK 1
QUANTITY FULL 320 LB
PRESSURE 865-935 PSIA
FILL TEMP - 297°F
SC00411 O_2 TANK 1 TEMP -325°TO-80°F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2 CRYO
CRYOGENIC GAS STORAGE SYSTEM
CSM 104
SIZE J
DWG NO 5.2
NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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SIGNATURES
CRYOGENIC TANKS
QUANTITY
PRESSURE
O2 TANK 1
O2 TANK 2
O2 HEATERS
H2 HEATERS
O2 FANS
H2 FANS
O2 PRESS IND
SURGE TANK
TANK 1
LOAD
TO SURGE TANK
DIFFERENTIATOR
CRYOGENIC FAN DUCTING
CRYO PRESS
28 VDC MCWS PWR
TO O2 TANK 2 QUANTITY SIGNAL CONDITIONER
TO H2 TANK 1 QUANTITY SIGNAL CONDITIONER
QTY AMPL 1
QTY AMPL 2
MDC 2
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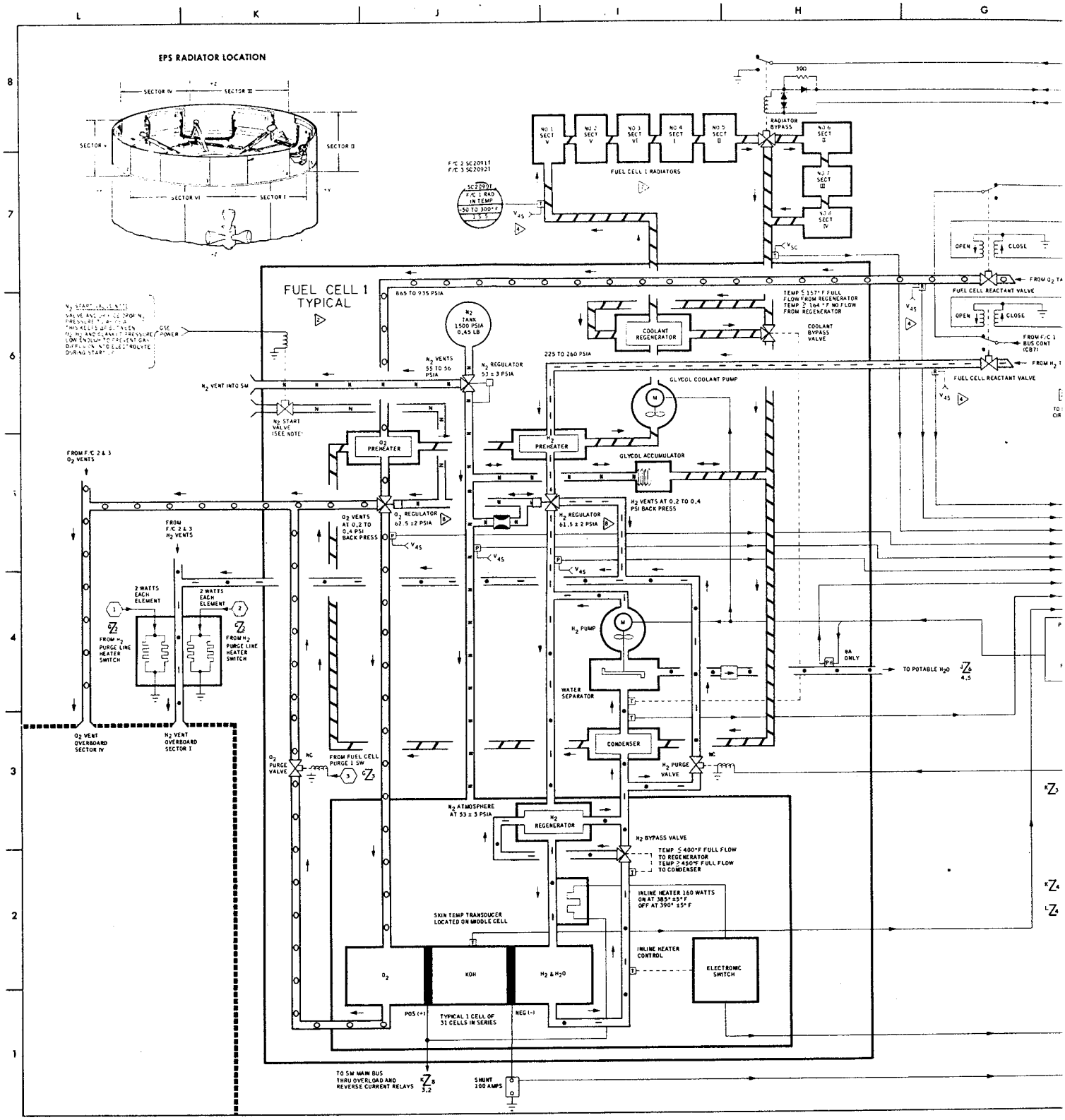
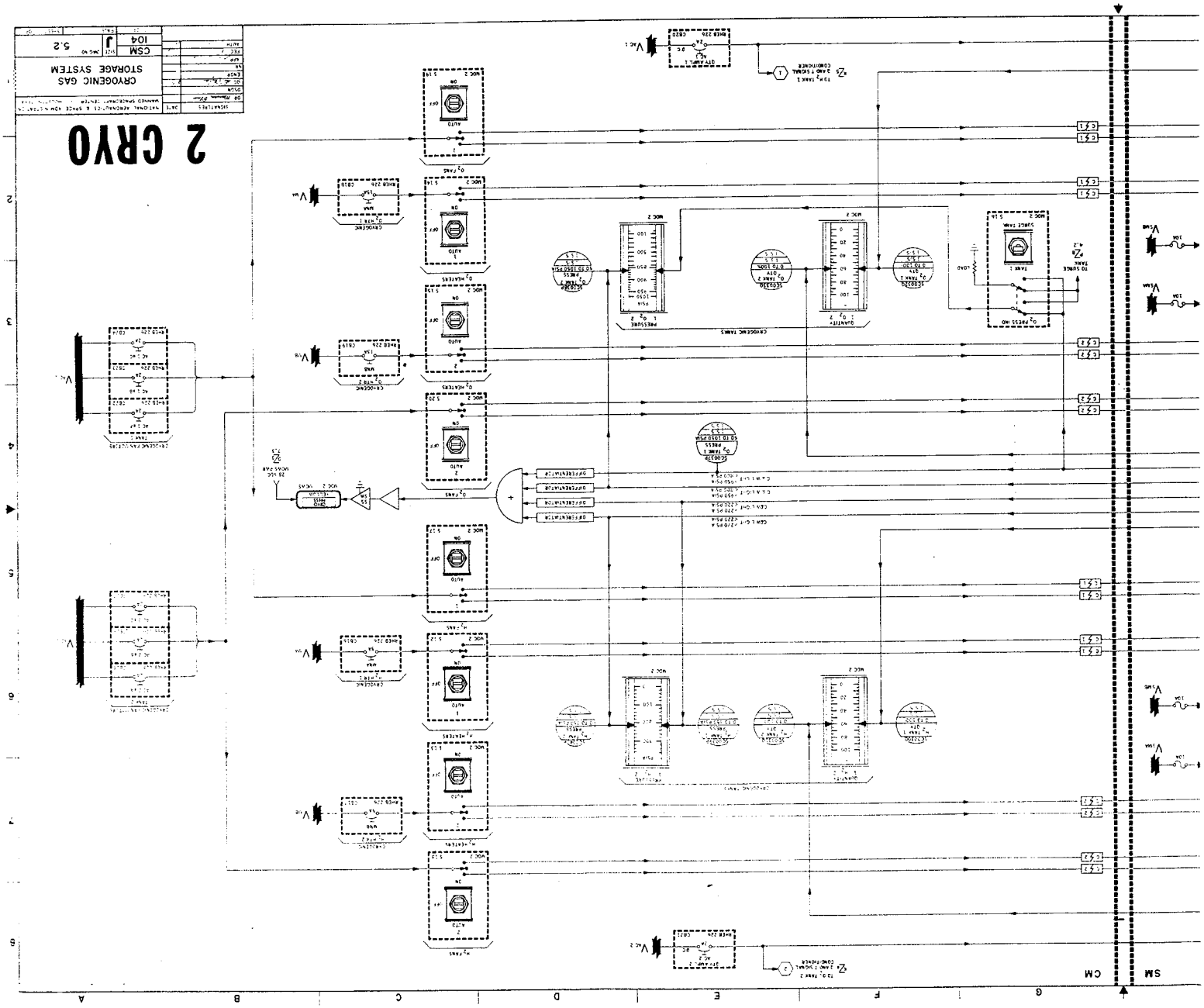

EPS RADIATOR LOCATION
SECTOR IV
SECTOR III
SECTOR V
SECTOR II
SECTOR VI
SECTOR I
FUEL CELL 1 TYPICAL
FUEL CELL 1 RADIATORS
RADIATOR BYPASS
NO.1 SECT V
NO.2 SECT V
NO.3 SECT VI
NO.4 SECT I
NO.5 SECT II
NO.6 SECT II
NO.7 SECT III
NO.8 SECT IV
F/C 2 SC2091T
F/C 3 SC2092T
SC2090T F/C 1 RAD IN TEMP -50 TO 300°F
865 TO 935 PSIA
N2 TANK 1500 PSIA 0.45 LB
N2 VENTS 55 TO 56 PSIA
N2 REGULATOR 53 ± 3 PSIA
N2 VENT INTO SM
N2 START VALVE (SEE NOTE)
225 TO 260 PSIA
COOLANT REGENERATOR
COOLANT BYPASS VALVE
TEMP ≤ 157°F FULL FLOW FROM REGENERATOR
TEMP ≥ 164°F NO FLOW FROM REGENERATOR
GLYCOL COOLANT PUMP
GLYCOL ACCUMULATOR
O2 PREHEATER
H2 PREHEATER
O2 REGULATOR 62.5 ±2 PSIA
H2 REGULATOR 61.5 ± 2 PSIA
O2 VENTS AT 0.2 TO 0.4 PSI BACK PRESS
H2 VENTS AT 0.2 TO 0.4 PSI BACK PRESS
FROM F/C 2 & 3 O2 VENTS
FROM F/C 2 & 3 H2 VENTS
2 WATTS EACH ELEMENT
FROM H2 PURGE LINE HEATER SWITCH
O2 VENT OVERBOARD SECTOR IV
H2 VENT OVERBOARD SECTOR I
H2 PUMP
WATER SEPARATOR
CONDENSER
TO POTABLE H2O
8A ONLY
O2 PURGE VALVE
FROM FUEL CELL PURGE 1 SW
H2 PURGE VALVE
N2 ATMOSPHERE AT 53 ± 3 PSIA
H2 REGENERATOR
H2 BYPASS VALVE
TEMP ≤ 400°F FULL FLOW TO REGENERATOR
TEMP ≥ 450°F FULL FLOW TO CONDENSER
INLINE HEATER 160 WATTS ON AT 385° ±5°F OFF AT 390° ±5°F
INLINE HEATER CONTROL
ELECTRONIC SWITCH
SKIN TEMP TRANSDUCER LOCATED ON MIDDLE CELL
O2
KOH
H2 & H2O
POS (+)
NEG (-)
TYPICAL 1 CELL OF 31 CELLS IN SERIES
TO SM MAIN BUS THRU OVERLOAD AND REVERSE CURRENT RELAYS
SHUNT 100 AMPS
FUEL CELL REACTANT VALVE
OPEN
CLOSE
FROM O2 TA
FROM F/C 1 BUS CONT (CB7)
FROM H2 T
TO CIR


2 CRYO
CRYOGENIC GAS
STORAGE SYSTEM
CSM
104
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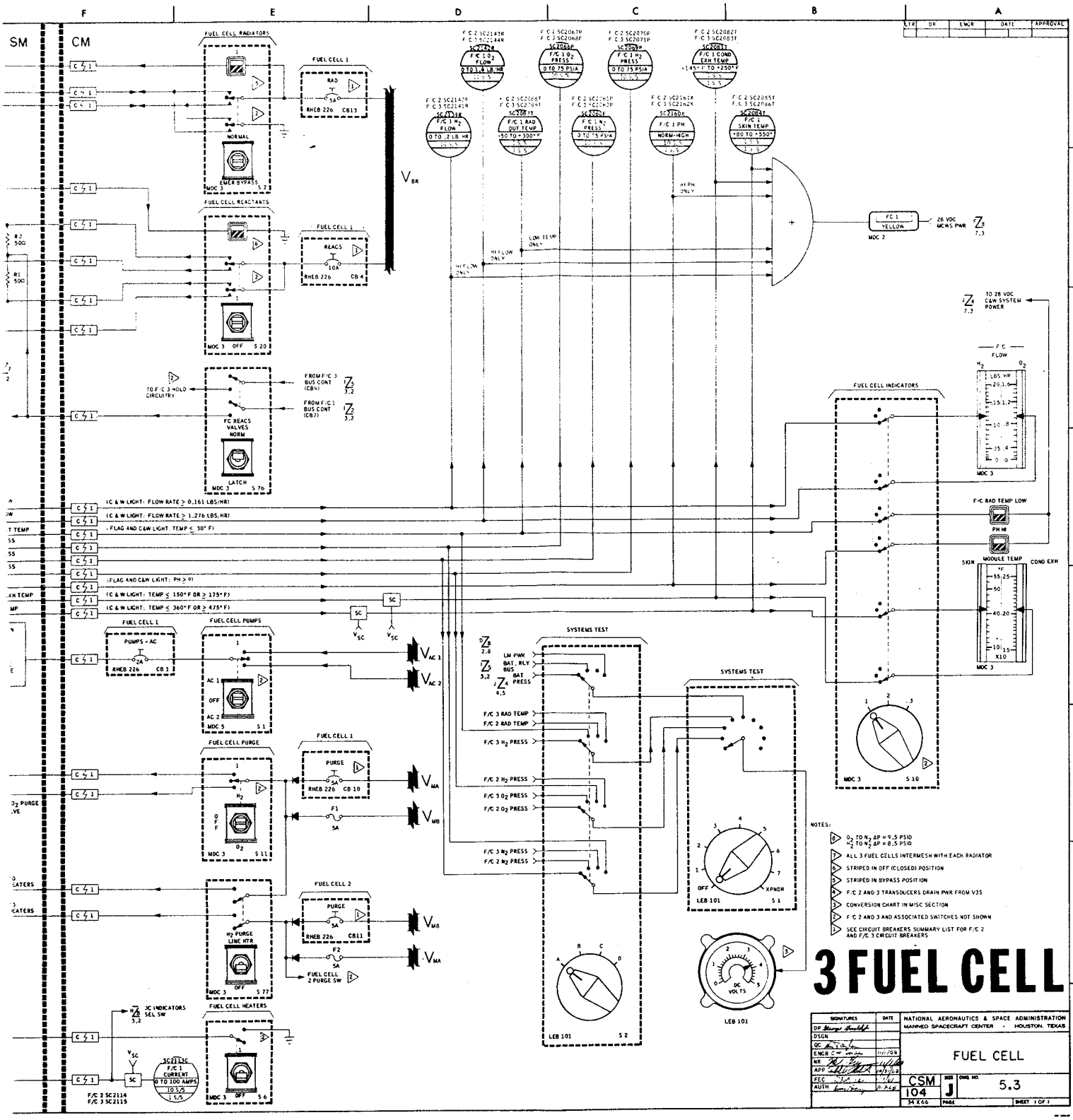
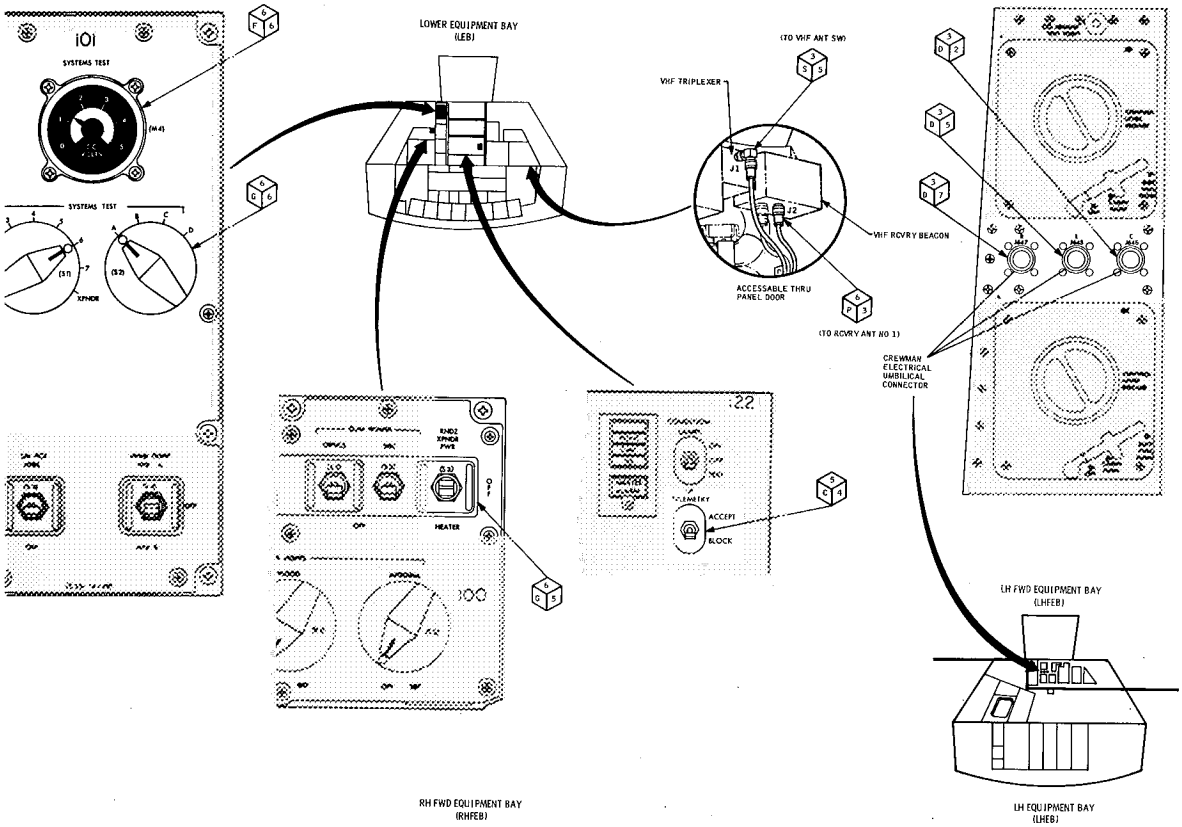
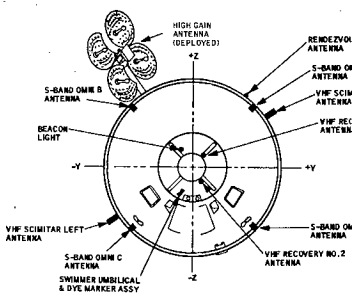
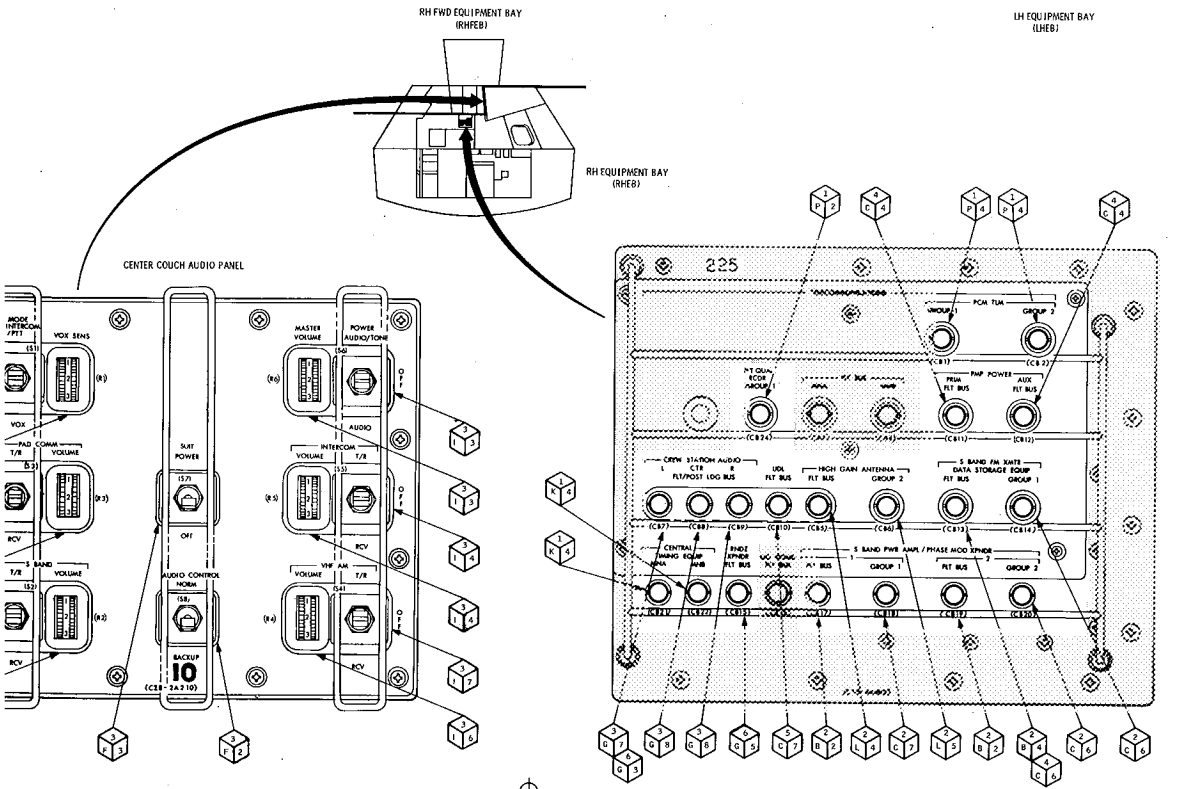
SM

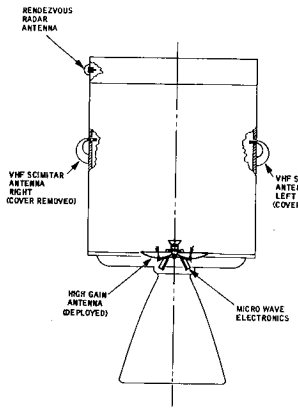

SM
CM
FUEL CELL RADIATORS
FUEL CELL 1
FUEL CELL REACTANTS
FUEL CELL 2
FUEL CELL INDICATORS
FUEL CELL PUMPS
FUEL CELL PURGE
FUEL CELL HEATERS
SYSTEMS TEST
F/C 1 O_2 FLOW
F/C 1 O_2 PRESS
F/C 1 H_2 PRESS
F/C 1 COND EXH TEMP
F/C 1 H_2 FLOW
F/C 1 RAD OUT TEMP
F/C 1 N_2 PRESS
F/C 1 PH
F/C 1 SKIN TEMP
V_{BR}
$V_{AC\,1}$
$V_{AC\,2}$
V_{MA}
V_{MB}
V_{M8}
V_{MA}
F/C RAD TEMP LOW
PH HI
SKIN
MODULE TEMP
COND EXH
LEB 101
NOTES:
3 FUEL CELL
NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS
FUEL CELL
CSM 104
5.3

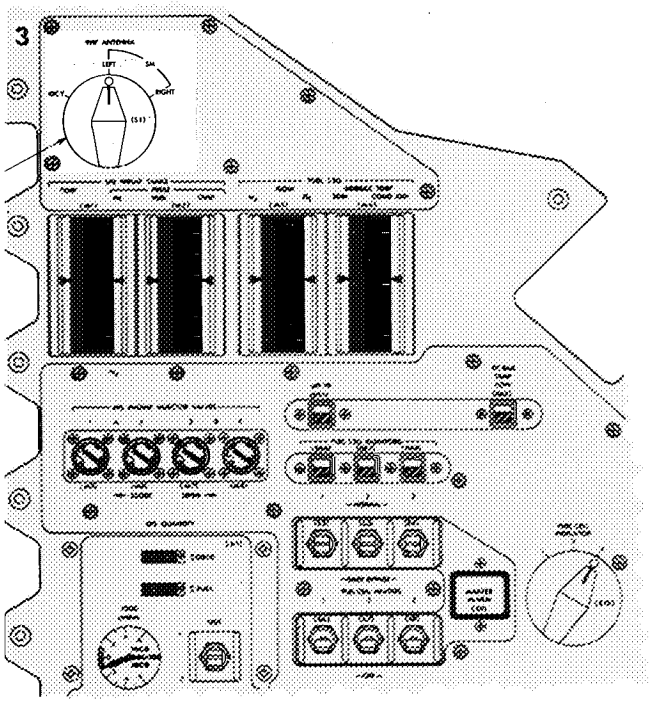
6 COMMUNI-
CATIONS
SYSTEM

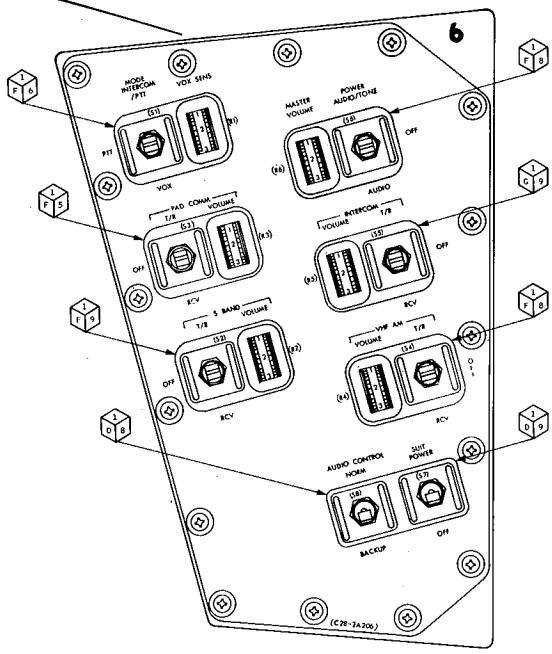

101
SYSTEMS TEST
SYSTEMS TEST
XPNDR
LOWER EQUIPMENT BAY
(LEB)
(TO VHF ANT SW)
VHF TRIPLEXER
J1
J2
VHF RCVRY BEACON
ACCESSABLE THRU
PANEL DOOR
(TO RCVRY ANT NO 1)
CREWMAN
ELECTRICAL
UMBILICAL
CONNECTOR
RNDZ
XPNDR
PWR
HEATER
ACCEPT
BLOCK
LH FWD EQUIPMENT BAY
(LHFEB)
LH EQUIPMENT BAY
(LHEB)


HIGH GAIN
ANTENNA
(DEPLOYED)
+Z
BEACON
LIGHT
-Y
+Y
VHF SCIMITAR LEFT
ANTENNA
S-BAND OMNI C
ANTENNA
SWIMMER UMBILICAL
& DYE MARKER ASSY
VHF RECOVERY NO.2
ANTENNA
-Z

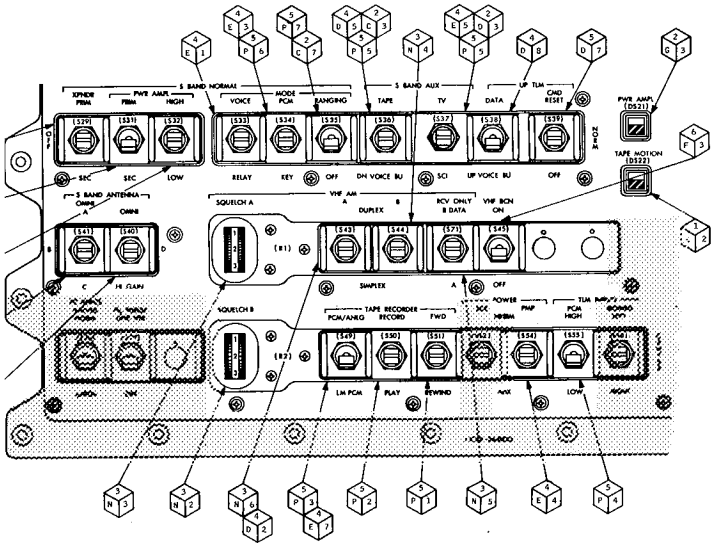

RH FWD EQUIPMENT BAY
(RHFEB)
RH EQUIPMENT BAY
(RHEB)
CENTER COUCH AUDIO PANEL
VOX SENS
MASTER
VOLUME
POWER
AUDIO/TONE
SUIT
POWER
AUDIO
INTERCOM
VOLUME
RCV
S BAND
VOLUME
VHF AM
AUDIO CONTROL
NORM
BACKUP
10
225
PCM TLM
GROUP 1
GROUP 2
PWR
PRIM
FLT BUS
AUX
FLT BUS
CREW STATION AUDIO
L
R
CTR
FLT/POST LOG BUS
UDL
FLT BUS
HIGH GAIN ANTENNA
GROUP 2
S BAND FM XMTR
DATA STORAGE EQUIP
GROUP 1
CENTRAL
WARNING EQUIP
RNDZ
XPNDR
FLT BUS
S BAND PWR AMPL / PHASE MOD XPNDR
GROUP 1
GROUP 2
FLT BUS

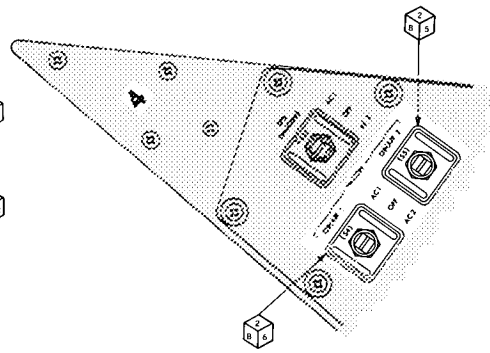

RENDEZVOUS
RADAR
ANTENNA
VHF SCIMITAR
ANTENNA
RIGHT
(COVER REMOVED)
VHF SCIMITAR
ANTENNA
LEFT
(COVER REMOVED)
HIGH GAIN
ANTENNA
(DEPLOYED)
MICRO WAVE
ELECTRONICS

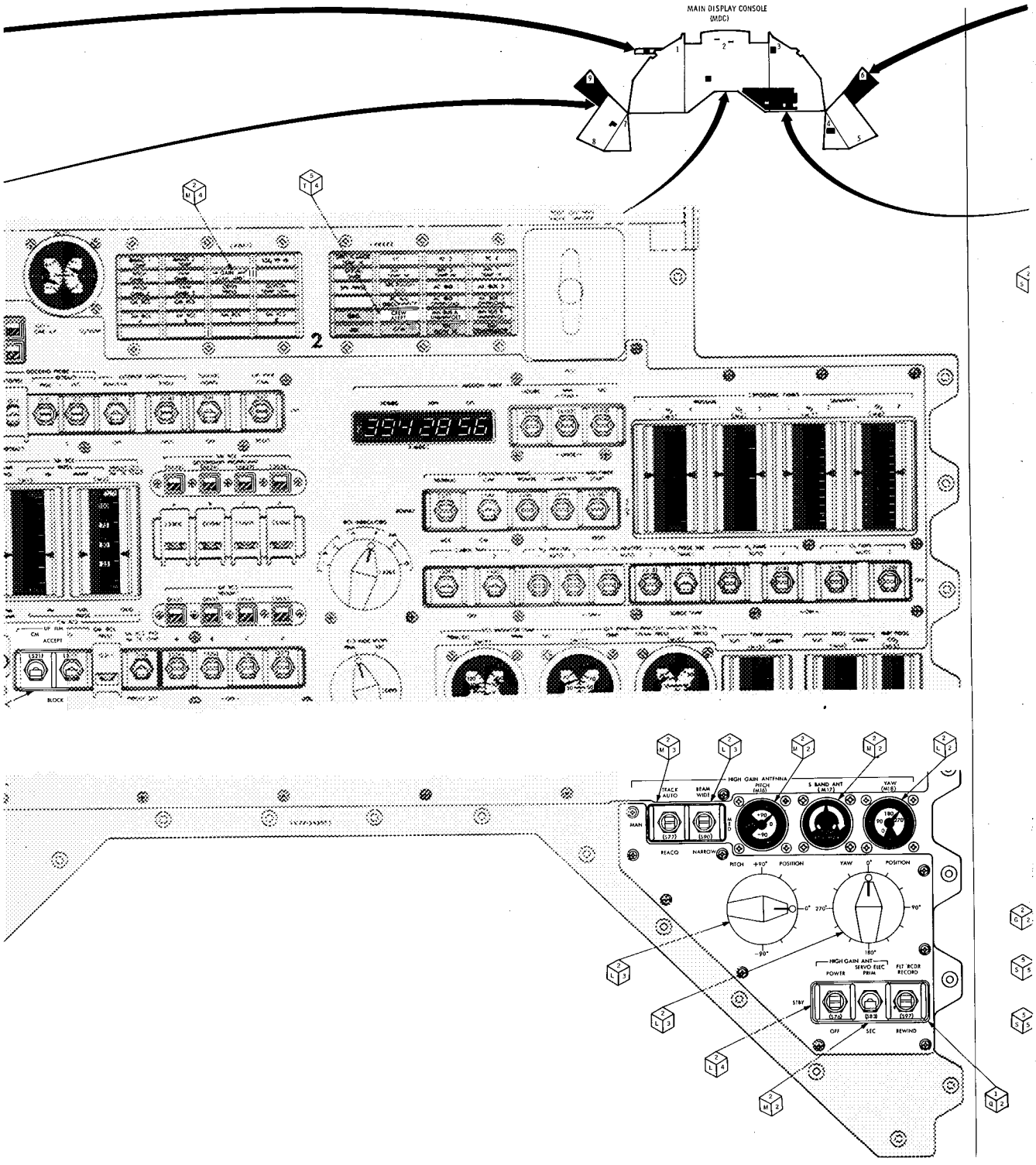


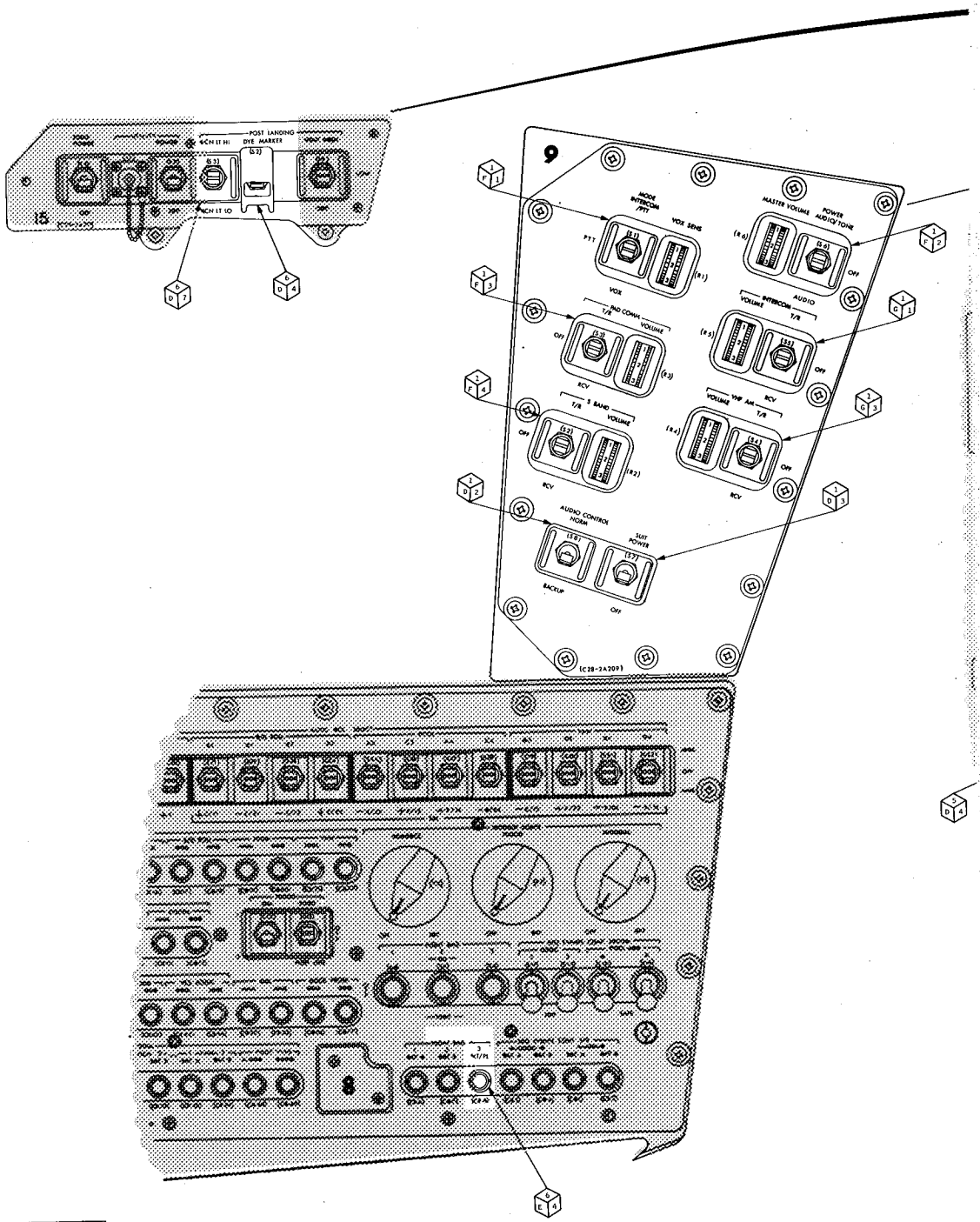


FOR CROSS REFERENCE SEE CENTER COUCH AUDIO PANEL NO 10 WHICH IS SHOWN AS TYPICAL FOR ALL THREE PANELS IN OWG COMM 3






MAIN DISPLAY CONSOLE
(MDC)
2
HIGH GAIN ANTENNA
PITCH
(M16)
S BAND ANT
(M17)
YAW
(M18)
TRACK
AUTO
BEAM
WIDE
MAN
REACQ
NARROW
PITCH +90° POSITION
YAW 0° POSITION
HIGH GAIN ANT
POWER
SERVO ELEC
PRIM
FLT RCDR
RECORD
STBY
OFF
SEC
REWIND

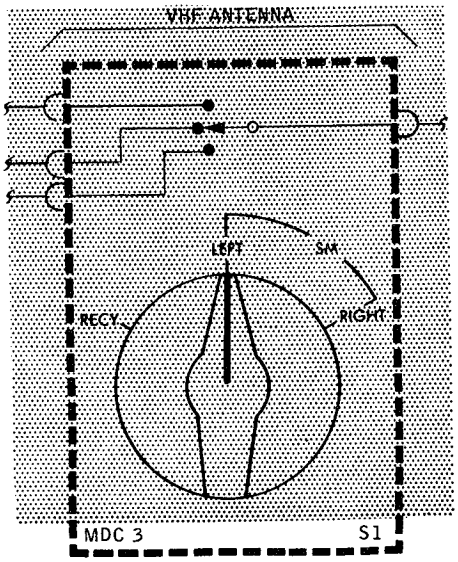


NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER · HOUSTON, TEXAS		
COMMUNICATIONS SYSTEM CONTROL–DISPLAY FIGURE		
DWG NO. FIGURE 6.1	SIZE J	CSM 104
SHEET OF	PAGE	11.4 X 36

SECTION 6

IS

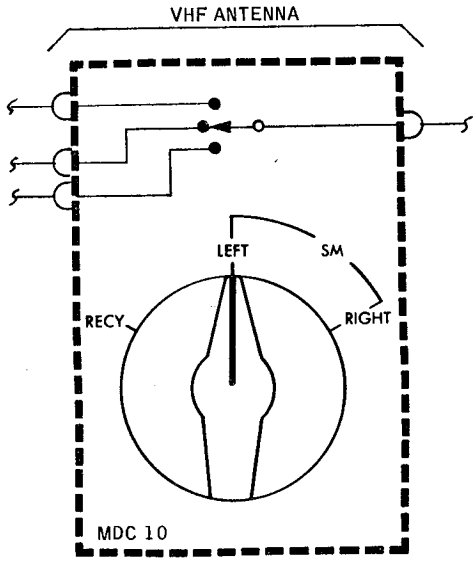
1. DWG 6.1 K Z 9,8



2. DWG 6.1 T,S Z 1

A - (2.1 TO 5 VDC)
B - RCVR AGC (0 TO 4.5 VDC)
C - FREQ LOCK (4 TO 5 VDC, OPERATE MODE & LOCKED)

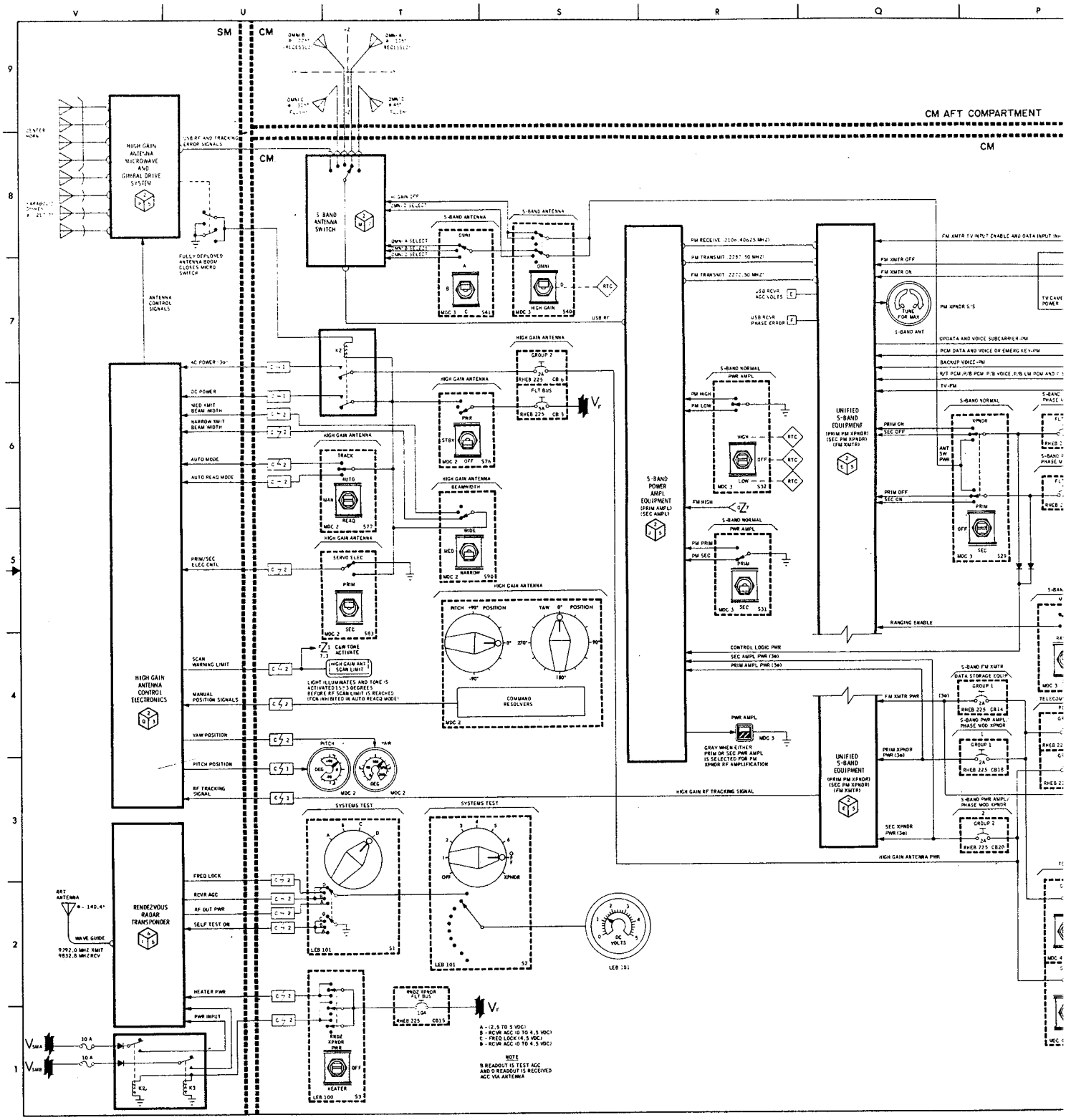
WAS

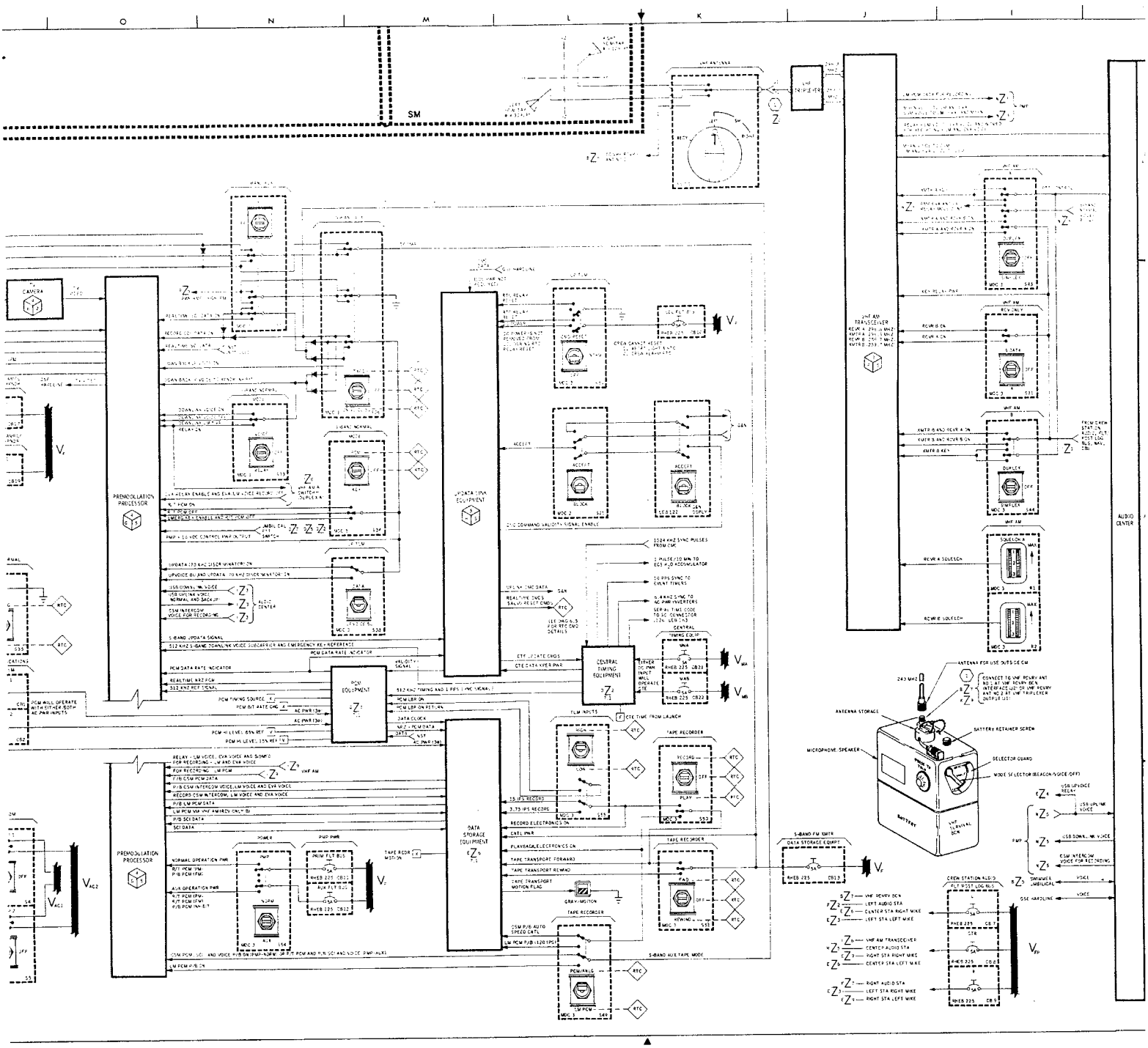


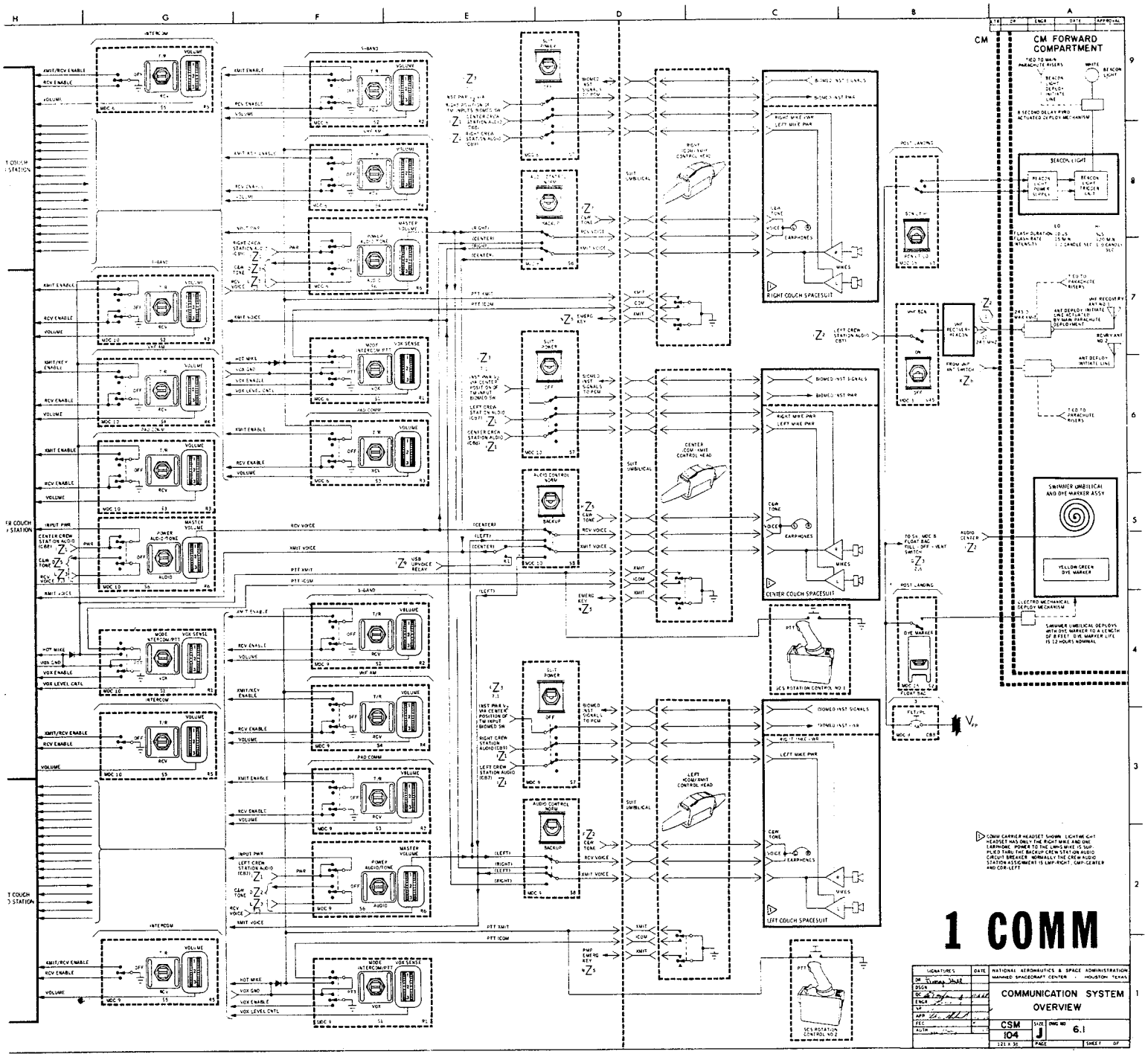
A - (2.5 TO 5 VDC)
B - RCVR AGC (0 TO 4.5 VDC)
C - FREQ LOCK (4.5 VDC)
D - RCVR AGC (0 TO 4.5 VDC)

NOTE

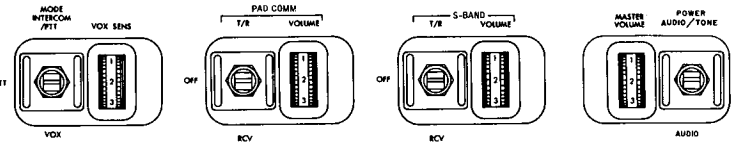
B READOUT IS TEST AGC
AND D READOUT IS RECEIVED
AGC VIA ANTENNA


SM
CM
CM AFT COMPARTMENT
HIGH GAIN ANTENNA MICROWAVE AND GIMBAL DRIVE SYSTEM
S BAND ANTENNA SWITCH
FULLY DEPLOYED ANTENNA BOOM CLOSES MICRO SWITCH
ANTENNA CONTROL SIGNALS
HIGH GAIN ANTENNA CONTROL ELECTRONICS
RENDEZVOUS RADAR TRANSPONDER
S-BAND POWER AMPL EQUIPMENT (PRIM AMPL) (SEC AMPL)
UNIFIED S-BAND EQUIPMENT (PRIM PM XPNDR) (SEC PM XPNDR) (FM XMTR)
S-BAND NORMAL PWR AMPL
S-BAND FM XMTR
S-BAND PWR AMPL/ PHASE MOD XPNDR
SYSTEMS TEST
COMMAND RESOLVERS
PITCH +90° POSITION
YAW 0° POSITION
HIGH GAIN RF TRACKING SIGNAL
HIGH GAIN ANTENNA PWR
RANGING ENABLE
CONTROL LOGIC PWR
SEC AMPL PWR (30)
PRIM AMPL PWR (30)
AC POWER 3Φ
DC POWER
MED XMIT BEAM WIDTH
NARROW XMIT BEAM WIDTH
AUTO MODE
AUTO REACQ MODE
PRIM/SEC ELEC CNTL
SCAN WARNING LIMIT
MANUAL POSITION SIGNALS
YAW POSITION
PITCH POSITION
RF TRACKING SIGNAL
FREQ LOCK
RCVR AGC
RF OUT PWR
SELF TEST ON
HEATER PWR
PWR INPUT
PM RECEIVE (210h-406.25 MHZ)
PM TRANSMIT (228.50 MHZ)
PM TRANSMIT (2272.50 MHZ)
USB RCVR AGC VOLTS
USB RCVR PHASE ERROR
FM XMTR OFF
FM XMTR ON
PM XPNDR S'S
UPDATA AND VOICE SUBCARRIER-PM
PCM DATA AND VOICE OR EMERG KEY-PM
BACKUP VOICE-PM
TV-FM
PRIM ON
SEC OFF
PRIM OFF
SEC ON
FM XMTR PWR
PRIM XPNDR PWR (30)
SEC XPNDR PWR (30)
GRAY WHEN EITHER PRIM OR SEC PWR AMPL IS SELECTED FOR PM XPNDR RF AMPLIFICATION
LIGHT ILLUMINATES AND TONE IS ACTIVATED 5°±3 DEGREES BEFORE RF SCAN LIMIT IS REACHED (FCN INHIBITED IN AUTO REACQ MODE)
A - (2.5 TO 5 VDC)
B - RCVR AGC (0 TO 4.5 VDC)
C - FREQ LOCK (4.5 VDC)
D - RCVR AGC (0 TO 4.5 VDC)
NOTE
B READOUT IS TEST AGC AND D READOUT IS RECEIVED AGC VIA ANTENNA
9792.0 MHZ XMIT 9832.8 MHZ RCV
10 A
10 A


SM
PREMODULATION PROCESSOR
PCM EQUIPMENT
CENTRAL TIMING EQUIPMENT
DATA STORAGE EQUIPMENT
UPDATA (TDA) EQUIPMENT
VHF AM TRANSCEIVER
AUDIO CENTER
TAPE RECORDER
ANTENNA STORAGE
BATTERY RETAINER SCREW
MICROPHONE-SPEAKER
SELECTOR GUARD
CREW STATION AUDIO


CM FORWARD COMPARTMENT
CM
INTERCOM
S-BAND
VHF AM
PAD COMM
RIGHT COUCH SPACESUIT
CENTER COUCH SPACESUIT
LEFT COUCH SPACESUIT
SUIT UMBILICAL
SWIMMER UMBILICAL AND DYE MARKER ASSY
YELLOW GREEN DYE MARKER
SCS ROTATION CONTROL NO 1
SCS ROTATION CONTROL NO 2
1 COMM
COMMUNICATION SYSTEM OVERVIEW
NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER - HOUSTON, TEXAS
CSM 104
SIZE J
DWG NO 6.1

AUDIO STATION MOD



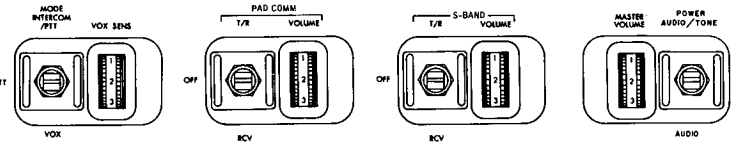
AUDIO STATION MODES		MODE INTERCOM /PTT	VOX SENS (1 = MINIMUM)	PAD COMM T/R	PAD COMM VOLUME (1 = MINIMUM)	S-BAND T/R	S-BAND VOLUME (1 = MINIMUM)	MASTER VOLUME	POWER AUDIO/TONE
SUIT POWER	ON (BIOMED INST AND MIKE)								
	OFF (BIOMED INST AND MIKE)								
XMT AND RCV (NORM)	CONTINUOUS INTERCOM PTT XMT (1)	INTERCOM/PTT				T/R	AS DESIRED	AS DESIRED	AUDIO/TONE AUDIO
	PTT INTERCOM (2) PTT XMT (3)	PTT				T/R	AS DESIRED	AS DESIRED	AUDIO/TONE AUDIO
	VOX INTERCOM VOX XMT	VOX	AS DESIRED			T/R	AS DESIRED	AS DESIRED	AUDIO/TONE AUDIO
RCV ONLY (NORM)	RCV ONLY					RCV	AS DESIRED	AS DESIRED	AUDIO/TONE AUDIO
XMT AND RCV (BACKUP)	RIGHT COUCH STATION								
	CENTER COUCH STATION								
	LEFT COUCH STATION								
RECORD	INTERCOM VOICE	INTERCOM/PTT PTT (4) VOX	AS DESIRED						AUDIO/TONE AUDIO
EMERG KEY	EMERGENCY KEY SIDETONE (400 HZ)					T/R RCV	AS DESIRED	AS DESIRED	AUDIO/TONE AUDIO
HARDLINE INTERCOM	SWIMMER UMBILICAL (6) LAUNCH COMPLEX (5)	INTERCOM/PTT PTT (5) VOX	AS DESIRED	T/R (5)	AS DESIRED				
C&W TONE	ENABLE C&W TONE								AUDIO/TONE
	DISABLE C&W TONE								AUDIO
UPLINK RELAY	MSFN VOICE - LM/EVA (CENTER STATION ONLY)	VOX	MAXIMUM (9)			OFF			AUDIO/TONE AUDIO
CONFERENCE	LM/EVA - CSM - MSFN (USE LEFT AND RIGHT STATIONS)	INTERCOM/PTT PTT VOX	AS DESIRED			T/R	AS DESIRED	AS DESIRED	AUDIO/TONE AUDIO

GENERAL NOTES:

1. CONTROLS SHOWN ARE TYPICAL FOR EACH AUDIO STATION. LEFT - MDC 9, CENTER-MDC 10 AND RIGHT-MDC 6
2. ROTATION CONTROLLER PTT BUTTON PERFORMS SAME FUNCTION AS COMM CABLE PTT CONTROL XMT FUNCTION EXCEPT NO EMERG KEY PTT CAPABILITY. ROTATION CONTROLLER NO. 2 FOR LEFT COUCH STATION AND ROTATION CONTROLLER NO. 1 FOR CENTER COUCH STATION
3. REMOVES +28 VDC VHF AM KEY RELAY POWER FROM COMM UMBILICAL AND COMM CABLE PTT CONTROL HEAD

NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER - HOUSTON, TEXAS	SIGNATURES	DATE
AUDIO STATION AND RF EQUIPMENT MODES AND CONTROL CHARTS	DR	
	DSGN	
	QC	11-66
	ENGR	10-66
	NR	10-66
	ADPO	10-66
	FEC	11/66
	AUTH	11-7-66
DWG NO 6.1A / SIZE J / CSM 104		
SHEET OF / PAGE		

AUDIO STATION MOD



AUDIO STATION MODES		MODE INTERCOM /PTT	VOX SENS (1 = MINIMUM)	PAD COMM T/R	PAD COMM VOLUME (1 = MINIMUM)	S-BAND T/R	S-BAND VOLUME (1 = MINIMUM)	MASTER VOLUME (1 = MINIMUM)	POWER AUDIO/TONE
SUIT POWER	ON (BIOMED INST AND MIKE)								
	OFF (BIOMED INST AND MIKE)								
XMT AND RCV (NORM)	CONTINUOUS INTERCOM PTT XMT (1)	INTERCOM/PTT				T/R	AS DESIRED	AS DESIRED	AUDIO/TONE AUDIO
	PTT INTERCOM (2) PTT XMT (3)	PTT				T/R	AS DESIRED	AS DESIRED	AUDIO/TONE AUDIO
	VOX INTERCOM VOX XMT	VOX	AS DESIRED			T/R	AS DESIRED	AS DESIRED	AUDIO/TONE AUDIO
RCV ONLY (NORM)	RCV ONLY					RCV	AS DESIRED	AS DESIRED	AUDIO/TONE AUDIO
XMT AND RCV (BACKUP)	RIGHT COUCH STATION								
	CENTER COUCH STATION								
	LEFT COUCH STATION								
RECORD	INTERCOM VOICE	INTERCOM/PTT PTT (4) VOX	AS DESIRED						AUDIO/TONE AUDIO
EMERG KEY	EMERGENCY KEY SIDETONE (400 HZ)					T/R RCV	AS DESIRED	AS DESIRED	AUDIO/TONE AUDIO
HARDLINE INTERCOM	SWIMMER UMBILICAL (6) LAUNCH COMPLEX (5)	INTERCOM/PTT PTT (5) VOX	AS DESIRED	T/R (5)	AS DESIRED				
C&W TONE	ENABLE C&W TONE								AUDIO/TONE
	DISABLE C&W TONE								AUDIO
UPLINK RELAY	MSFN VOICE - LM/EVA (CENTER STATION ONLY)	VOX	MAXIMUM (9)			OFF			AUDIO/TONE AUDIO
CONFERENCE	LM/EVA - CSM - MSFN (USE LEFT AND RIGHT STATIONS)	INTERCOM/PTT PTT VOX	AS DESIRED			T/R	AS DESIRED	AS DESIRED	AUDIO/TONE AUDIO

GENERAL NOTES:

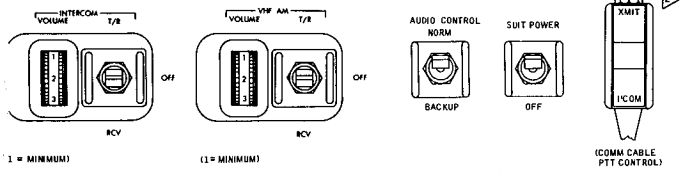
1. CONTROLS SHOWN ARE TYPICAL FOR EACH AUDIO STATION. LEFT - MDC 9, CENTER-MDC 10 AND RIGHT-MDC 6
2. ROTATION CONTROLLER PTT BUTTON PERFORMS SAME FUNCTION AS COMM CABLE PTT CONTROL XMT FUNCTION EXCEPT NO EMERG KEY PTT CAPABILITY. ROTATION CONTROLLER NO. 2 FOR LEFT COUCH STATION AND ROTATION CONTROLLER NO. 1 FOR CENTER COUCH STATION
3. REMOVES +28 VDC VHF AM KEY RELAY POWER FROM COMM UMBILICAL AND COMM CABLE PTT CONTROL HEAD

NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER · HOUSTON, TEXAS	SIGNATURES	DATE
	DR	
	DSGN	
	QC	
	ENGR	
	NR	
	AD	
	FEC	
	AUTH	

AUDIO STATION AND RF EQUIPMENT MODES AND CONTROL CHARTS

DWG NO	SIZE	
6.1A	J	CSM 104
SHEET OF	PAGE	

8 CONTROLS [1]



								SPECIAL INSTRUCTIONS AND NOTES:
					SUIT POWER			SUIT POWER NOT REQUIRED FOR EARPHONES
			OFF [3] / RCV [3]		OFF			SUIT POWER NOT REQUIRED FOR EARPHONES
AS DESIRED	T/R	AS DESIRED	T/R	NORM	SUIT POWER	XMT (1) [2]		USE S-BAND, INTERCOM, AND/OR VHF AM T/R CONTROLS AS REQUIRED FOR COMM LINK DESIRED
AS DESIRED	T/R	AS DESIRED	T/R	NORM	SUIT POWER	I-COM (2) / XMT (3) [2]		USE S-BAND, INTERCOM, AND/OR VHF AM T/R CONTROLS AS REQUIRED FOR COMM LINK DESIRED
AS DESIRED	T/R	AS DESIRED	T/R	NORM	SUIT POWER			USE S-BAND INTERCOM AND/OR VHF AM T/R CONTROLS AS REQUIRED FOR COMM LINK DESIRED
AS DESIRED	RCV	AS DESIRED	RCV	NORM	SUIT POWER / OFF			SUIT POWER NOT REQUIRED FOR EARPHONES
				BACKUP	SUIT POWER			USE CENTER COUCH STATION CONTROLS AND CONFIGURE FOR DESIRED MODE
				BACKUP	SUIT POWER			USE LEFT COUCH STATION CONTROLS AND CONFIGURE FOR DESIRED MODE. NOTE: DURING RELAY OPERATIONS THE CENTER COUCH ASTRONAUT SHOULD GO BACK UP MODE SINCE UPLINK VOICE REQUIRES HIS MIKE LINK
				BACKUP	SUIT POWER			USE RIGHT COUCH STATION CONTROLS AND CONFIGURE FOR DESIRED MODE
	T/R			NORM / BACKUP	SUIT POWER	I-COM (4)		SEE DSE - CSM VOICE RECORD MODE FOR DSE SWITCH POSITIONS
						XMT [2]		
AS DESIRED	T/R (6)			NORM / BACKUP	SUIT POWER	XMT / I-COM		VOX MODE WILL OPERATE RF XMTRS IF VHF AM AND/OR S-BAND IS IN T/R MODE
			T/R					UPLINK VOICE RELAY FROM MSFN USES CENTER COUCH STATION MIKE INPUT. CENTER COUCH ASTRONAUT SHOULD GO TO BACKUP MODE AND USE LEFT STATION CONTROLS
		AS DESIRED	T/R	NORM / BACKUP	SUIT POWER			SEE XMT AND RCV - BACKUP MODE IF AUDIO CONTROL "BACKUP" SWITCH POSITION IS USED. CENTER COUCH STATION IS USED FOR UPLINK RELAY AND HAS NO TALK CAPABILITY, ONLY MONITOR

COMMUNICATION M

S-BAND FM - RECEIVE
- VOICE (NORMAL)
- VOICE (BACK - U
- UP - DAT
- RANGING
- MSFN VOI AND/OR E (NORMAL)
- MSFN VOI AND/OR E (BACKUP)

S - BAND FM - TRANSMIT
- VOICE (NORMAL)
- VOICE (BACK-UP
- CSM PCM
- EMERGE
- LM VOICE EVA VOIC BIOMED

S-BAND FM TRANSMIT
- TELEVIS
- ANALOG (REAL TI
- CSM PCM (REAL TI
- ANALOG (PLAYBA
- CSM VOI CSM PCM LM VOIC
- LM PCM (PLAYBA

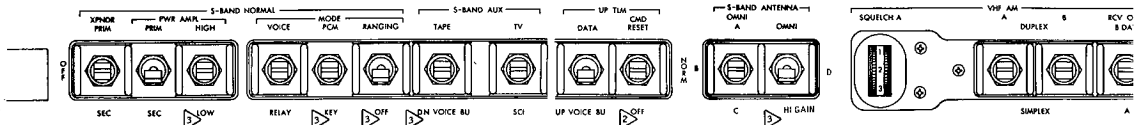
DATA STORAGE EQUIPMENT
- CSM PCM (RECORD)
- LM PCM (RECORD)
- CSM VOI (RECORD)
- CSM VOI VOICE (R
- SCIENTIF (RECORD)
- PLAYBA (PLAYBA
- REWIND
- FAST FO

VHF - AM RECEIVE
- MSFN VO
- LM VOIC
- EVA VOI
- LM PCM
- EVA BIO

VHF - AM TRANSMIT
- VOICE -
- VOICE -
- VOICE -

RECOVERY
- VOICE (V (TWO-W
- BCN (REC
- BCN OR V (VHF SR

NOTE:



	PRIM / SEC				DATA			
	PRIM / SEC				UP VOICE BU		SELECT OMNI ANTENNA WITH BEST LOOK ANGLE TO MSFN, USE S-BAND ANTENNA METER, MDC 3 FOR INDICATION OF ANTENNA RECEIVING STRONGEST SIGNAL	
	PRIM / SEC				DATA / UP VOICE BU	NORM		
	PRIM / SEC		RANGING					
AY-LM	PRIM / SEC		RELAY		DATA			DUPLEX / SIMPLEX OR DUPLEX / SIMPLEX
Y-LM	PRIM / SEC		RELAY		UP VOICE BU			DUPLEX / SIMPLEX OR DUPLEX / SIMPLEX
	PRIM / SEC		VOICE / RELAY		TAPE (CENTER)			
	PRIM / SEC	SELECT PRIM OR SEC PWR AMPL FOR PM TRANSMIT AND HIGH, BYPASS OR LOW POWER LEVEL AS REQUIRED TO MEET COMM CIRCUIT MARGINS	4 OFF		DN VOICE BU		SELECT OMNI ANTENNA WITH BEST LOOK ANGLE TO MSFN, USE S-BAND ANTENNA METER, MDC 3 FOR INDICATION OF ANTENNA RECEIVING STRONGEST SIGNAL	
	PRIM / SEC		PCM					
	PRIM / SEC		KEY OFF		TAPE (CENTER)			
	PRIM / SEC		RELAY / PCM OFF		TAPE (CENTER)		SET SQUELCH TO MINIMUM (1)	DUPLEX
					(CENTER) DN VOICE BU	TV		
		ALTERNATE POWER AMPL (PRIM/SEC) WILL AUTOMATICALLY BE SELECTED BY S-BAND AUX SWITCHES IN HIGH PWR MODE FOR ALL FM MODES. FM TRANSMITTER WILL BE ACTIVATED BY THE SAME SWITCHES			(CENTER) DN VOICE BU	SCI	SELECT OMNI ANTENNA WITH BEST LOOK ANGLE TO MSFN, USE S-BAND ANTENNA METER, MDC 3 FOR INDICATION OF ANTENNA RECEIVING STRONGEST SIGNAL	
					TAPE			
					TAPE			
YBACK)					TAPE			
					TAPE			B DA
M							SET SQUELCH TO MINIMUM (1)	SIMPLEX OR DUPLEX / SIMPLEX OR A
					(CENTER) DN VOICE BU AND TV CENTER			
S		SEE S-BAND FM PLAYBACK MODES			SEE S-BAND FM PLAYBACK MODES			
							SET SQUELCH AS DESIRED	DUPLEX / SIMPLEX OR DUPLEX / SIMPLEX
							SET SQUELCH AS DESIRED	DUPLEX / SIMPLEX OR DUPLEX / SIMPLEX
							SET SQUELCH AS DESIRED	DUPLEX / SIMPLEX OR DUPLEX / SIMPLEX
								B DA
							SET SQUELCH TO MINIMUM (1)	DUPLEX
								DUPLEX / SIMPLEX OR DUPLEX / SIMPLEX
								DUPLEX / SIMPLEX OR DUPLEX / SIMPLEX
								DUPLEX / SIMPLEX OR DUPLEX / SIMPLEX
								DUPLEX / SIMPLEX OR DUPLEX / SIMPLEX
CN)								
CVR)								

E HI GAIN ANTENNA PER FLIGHT PLAN AND MISSION PROCEDURES

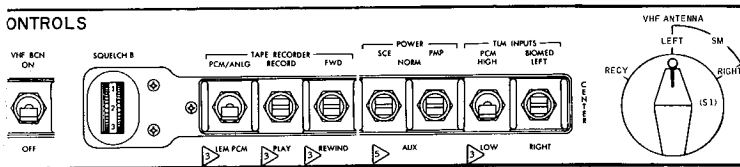
AD RESET" POSITION RESETS ALL REALTIME COMMANDS AFFECTING COMMUNICATION NTROLS. RESET RETURNS CONTROL TO MDC 3 SWITCHES

NTROLLABLE BY REALTIME COMMANDS (SEE DWG 6.3 FOR CMD LIST)

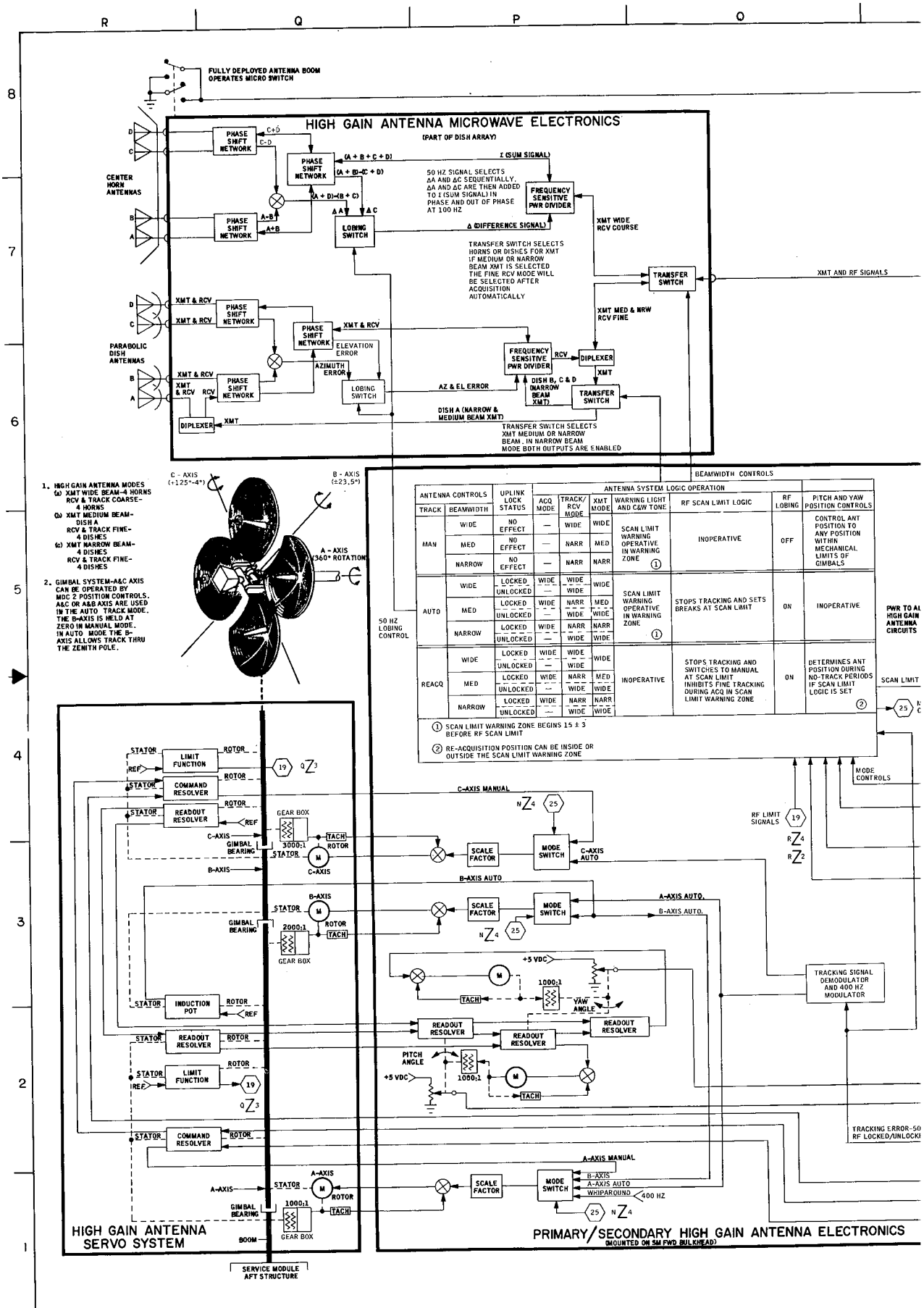
NGING INTERFERES WITH DN VOICE BU

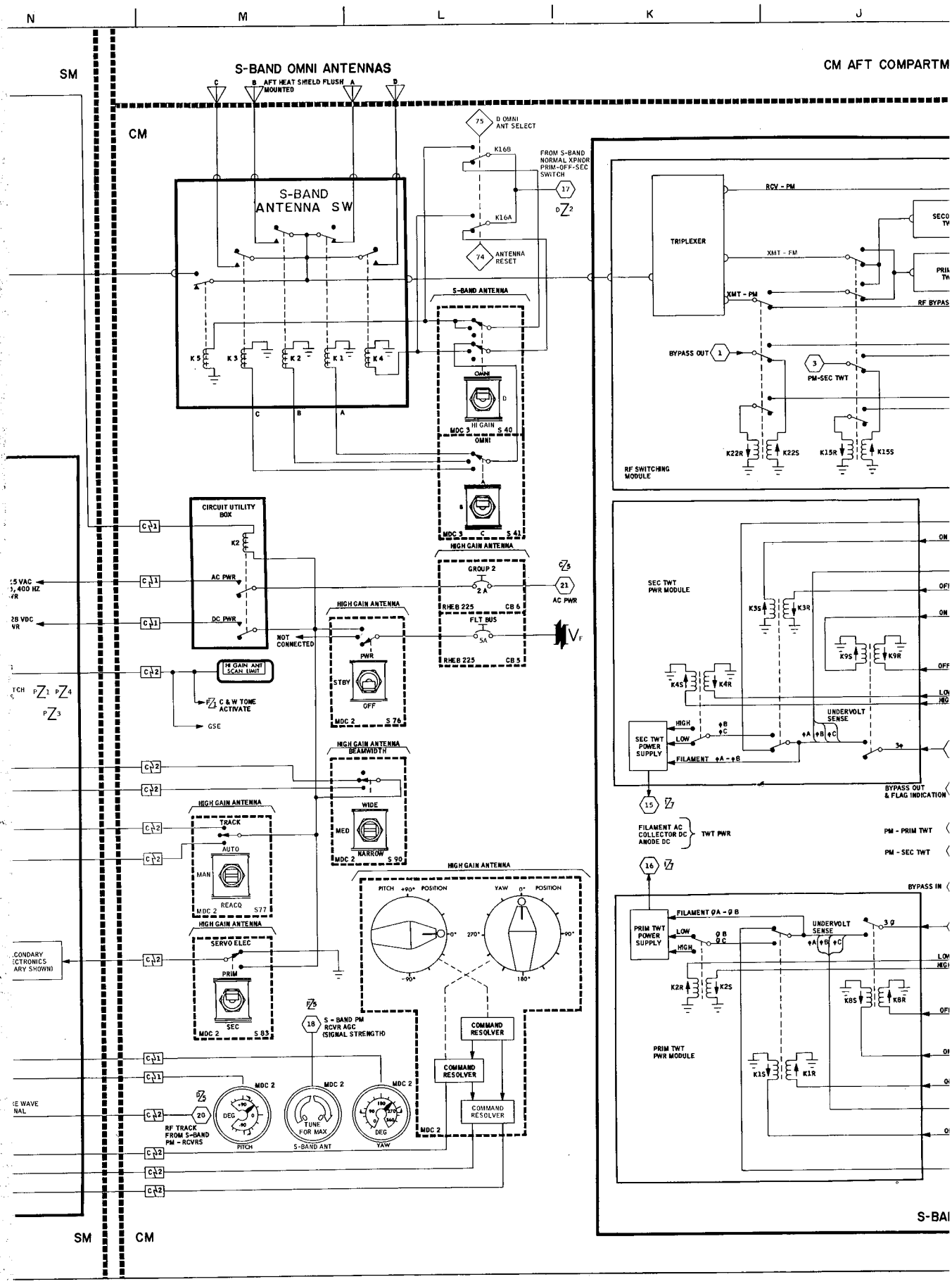
5 SWITCH NOT REQUIRED FOR COM MODES

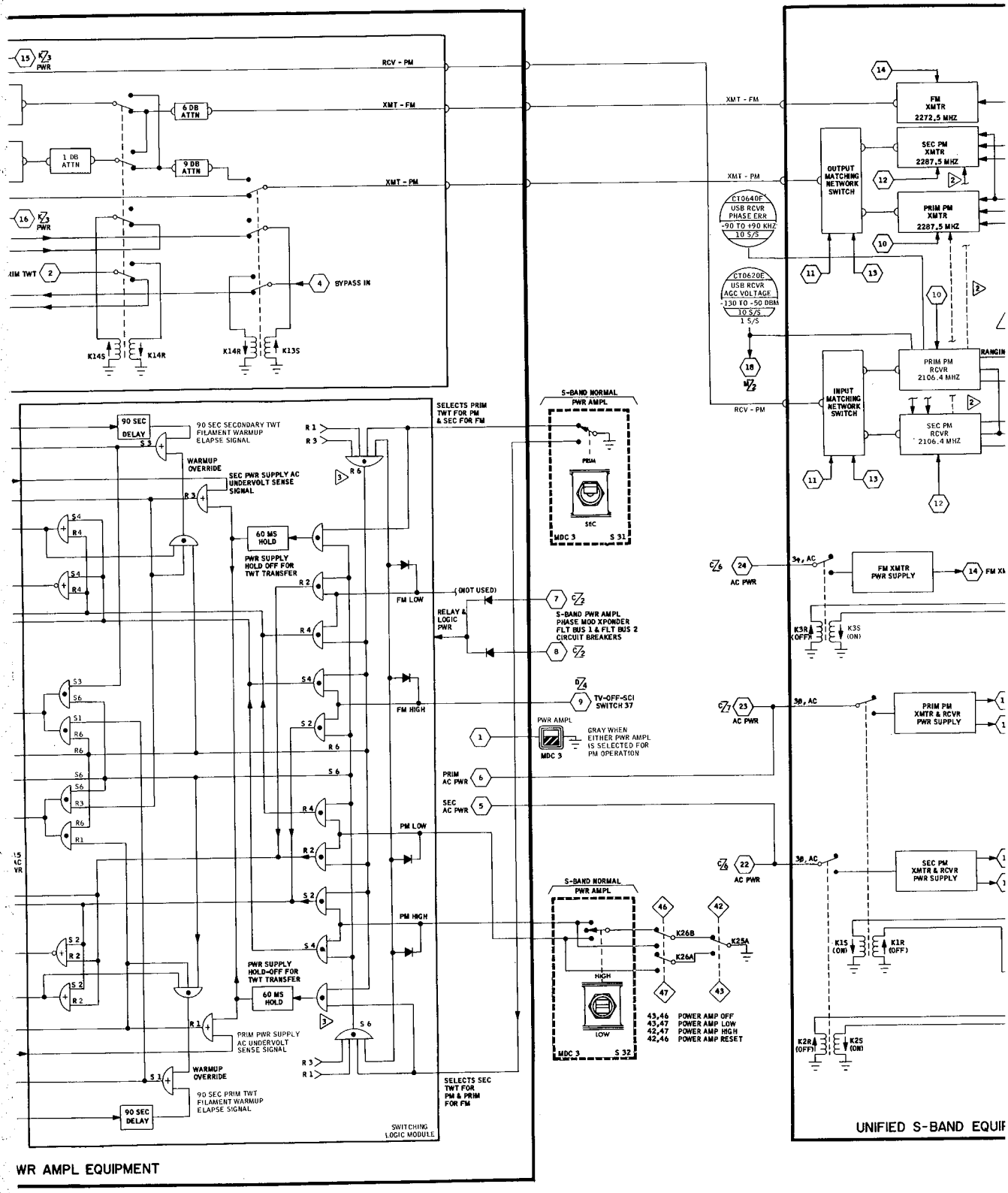
ONTROLS

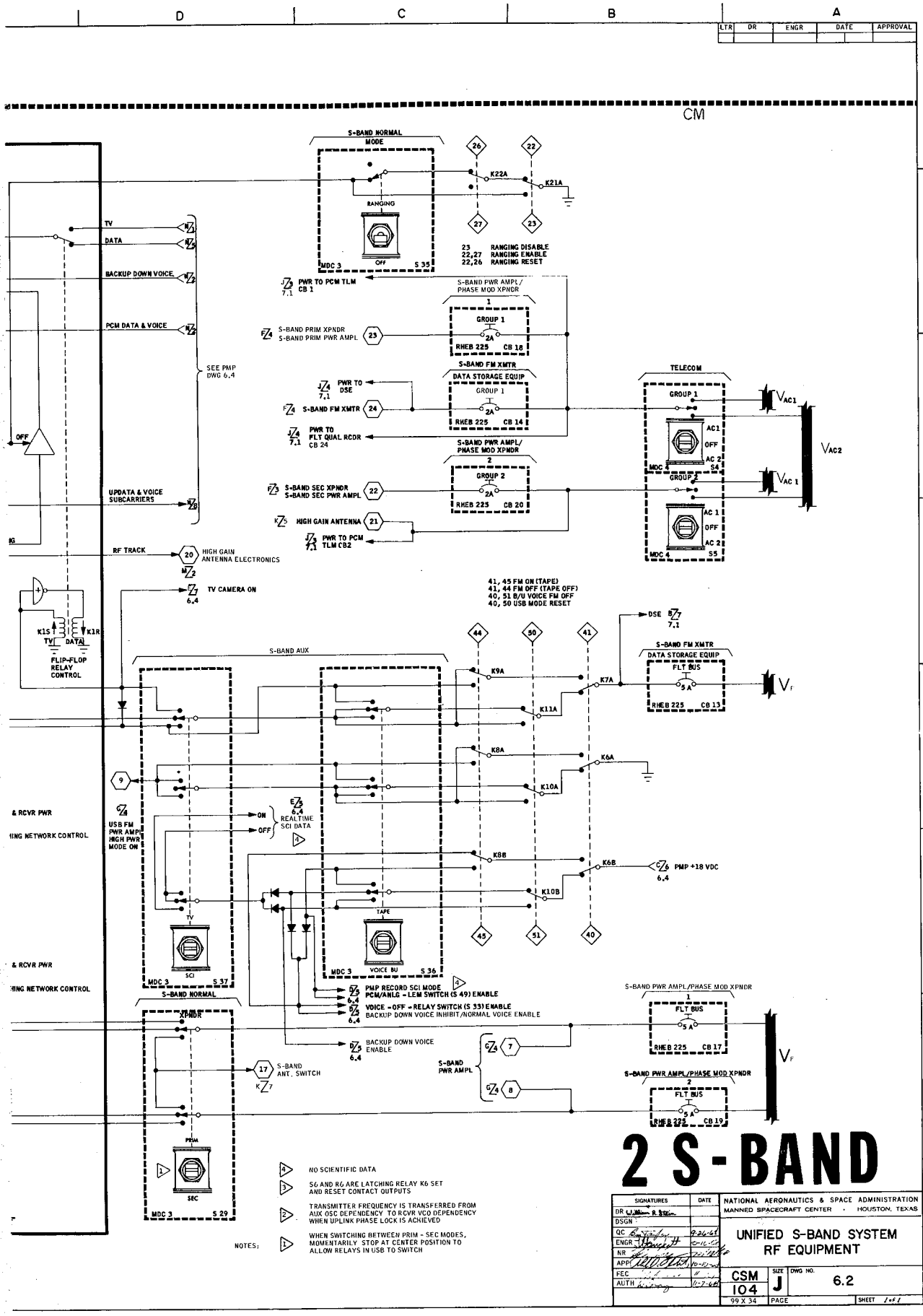


									SPECIAL INSTRUCTIONS AND NOTES:
						NORM / AUX			SEE AUDIO STATION MODES
						NORM / AUX			SEE AUDIO STATION MODES
						NORM / AUX			UPDATA WILL TIME SHARE THE 70 KHZ PMP DISCRIMINATOR WHEN IN THE UP VOICE BACKUP MODE
						NORM / AUX		SELECT ANTENNA WITH BEST LOOK ANGLE TO MSFN, EVA OR LM AS REQUIRED	SEE AUDIO STATION RELAY AND CONFERENCE MODES
						NORM / AUX		SELECT ANTENNA WITH BEST LOOK ANGLE TO MSFN, EVA OR LM AS REQUIRED	SEE AUDIO STATION RELAY AND CONFERENCE MODES
						NORM / AUX			SEE AUDIO STATION MODES
						NORM / AUX			SEE AUDIO STATION MODES
						NORM / AUX	HIGH / LOW		PMP AUX INHIBITS P/B PCM
						NORM / AUX			TO KEY EMERGENCY KEY SIGNAL PRESS THE XMT PUSHBUTTON ON THE COMMUNICATION CABLE CONTROL HEAD. SEE AUDIO STATION EMERGENCY KEY MODE
						NORM / AUX		SELECT ANTENNA WITH BEST LOOK ANGLE TO MSFN, EVA OR LM AS REQUIRED	
						NORM / AUX			PLACE ON-OFF POWER SWITCH ON TV CAMERA TO ON AND AUTOMATIC LIGHT CONTROL SWITCH TO ALC OR OFF AS REQUIRED
						NORM / AUX			NO ANALOG (SCIENTIFIC) DATA ON SC 104
		PCM/ANLG				AUX	HIGH / LOW		THIS MODE INHIBITS PLAYBACK OF RECORDED CSM PCM
		PCM/ANLG	PLAY	FWD		NORM / AUX			NO ANALOG (SCIENTIFIC) DATA ON SC 104
		PCM/ANLG	PLAY	FWD		NORM			PLAYBACK SPEED DETERMINED BY CSM PCM BIT RATE RECORDED HIGH 1 5 IPS (30 MINUTES) LOW 120 IPS (3,75 MINUTES)
		LM/PCM	PLAY	FWD		NORM / AUX			DSE WILL PLAYBACK LM PCM AT 120 IPS ALWAYS. ANY OTHER DATA ON TAPE WILL NOT BE ERASED.
			RECORD	FWD			HIGH / LOW		RECORD SPEED IS DETERMINED BY PCM HIGH/LOW SWITCH HIGH 1 5 IPS (30 MINUTES) LOW 3,75 IPS (120 MIN)
	SET SQUELCH TO MINIMUM (1)		RECORD	FWD		NORM / AUX		SELECT ANTENNA WITH BEST LOOK ANGLE TO MSFN, EVA OR LM AS REQUIRED	SPEED AT WHICH LM PCM IS RECORDED IS DETERMINED BY PCM - HIGH/LOW SWITCH
			RECORD	FWD		NORM / AUX			SELECT THE AUDIO STATION RECORD INTERCOM VOICE MODE
			RECORD	FWD		NORM / AUX		SELECT ANTENNA WITH BEST LOOK ANGLE TO MSFN, EVA OR LM AS REQUIRED	SELECT THE AUDIO STATION RECORD INTERCOM VOICE MODE DUPLEX A INHIBITS VHF VOICE TO DSE
			RECORD	FWD		NORM / AUX			NO SCI DATA ON SC 104
			PLAY	FWD		SEE S-BAND FM MODES			PLAYBACK SPEED IS DETERMINED BY CSM PCM BIT RATE RECORDED HIGH 1 5 IPS (30 MINUTES) LOW 120 IPS (3,75 MINUTES)
				REWIND					DSE MUST BE REWOUND BEFORE RECORDED DATA CAN BE PLAYED BACK. REWIND SPEED 120 IPS (3,75 MINUTES)
			CENTER	FWD					DSE WILL RUN AT 120 IPS. DATA ON TAPE WILL NOT BE ERASED
	SET SQUELCH AS DESIRED								SEE AUDIO STATION MODES
	SET SQUELCH AS DESIRED								SEE AUDIO STATION MODES
	SET SQUELCH AS DESIRED							SELECT ANTENNA WITH BEST LOOK ANGLE TO MSFN, EVA OR LM AS REQUIRED	SEE AUDIO STATION MODES
	SET SQUELCH TO MINIMUM (1)		RECORD	FWD		NORM / AUX			LM PCM CANNOT BE RELAYED IN REAL TIME, IT MUST BE RECORDED ON DSE AND PLAYED BACK TO MSFN VIA S-BAND FM MODE
	SET SQUELCH TO MINIMUM (1)								EVA BIOMED IS TRANSMITTED TO THE CSM ON B FREQUENCY ONLY AND RELAYED IN REAL TIME VIA USB
									SEE AUDIO STATION MODES
								SELECT ANTENNA WITH BEST LOOK ANGLE TO MSFN, EVA OR LM AS REQUIRED	SEE AUDIO STATION MODES
									SEE AUDIO STATION MODES
								RECY	ANTENNA DEPLOYED WHEN PARACHUTES DEPLOYED
	ON								USE ONLY AFTER PARACHUTE DEPLOYMENT AT WHICH TIME RECOVERY ANTENNA NO. 1 IS DEPLOYED AUTOMATICALLY
								RECY	SELECT BEACON OR VOICE MODE ON VHF SURVIVAL BCN-TRANSCEIVER. TO OPERATE UNIT IN CM, CONNECT VHF RCVRY ANTENNA NO. 1 OR NO. 2 (VHF ANT. SW TO RECY) TO UNIT


R
Q
P
O
8
7
6
5
4
3
2
1
FULLY DEPLOYED ANTENNA BOOM OPERATES MICRO SWITCH
HIGH GAIN ANTENNA MICROWAVE ELECTRONICS
(PART OF DISH ARRAY)
CENTER HORN ANTENNAS
PARABOLIC DISH ANTENNAS
PHASE SHIFT NETWORK
LOBING SWITCH
FREQUENCY SENSITIVE PWR DIVIDER
TRANSFER SWITCH
DIPLEXER
50 HZ SIGNAL SELECTS ΔA AND ΔC SEQUENTIALLY. ΔA AND ΔC ARE THEN ADDED TO Σ (SUM SIGNAL) IN PHASE AND OUT OF PHASE AT 100 HZ
TRANSFER SWITCH SELECTS HORNS OR DISHES FOR XMT IF MEDIUM OR NARROW BEAM XMT IS SELECTED THE FINE RCV MODE WILL BE SELECTED AFTER ACQUISITION AUTOMATICALLY
XMT WIDE RCV COURSE
XMT MED & NRW RCV FINE
XMT AND RF SIGNALS
AZ & EL ERROR
DISH A (NARROW & MEDIUM BEAM XMT)
TRANSFER SWITCH SELECTS XMT MEDIUM OR NARROW BEAM. IN NARROW BEAM MODE BOTH OUTPUTS ARE ENABLED
1. HIGH GAIN ANTENNA MODES
(a) XMT WIDE BEAM-4 HORNS
RCV & TRACK COARSE-4 HORNS
(b) XMT MEDIUM BEAM-DISH A
RCV & TRACK FINE-4 DISHES
(c) XMT NARROW BEAM-4 DISHES
RCV & TRACK FINE-4 DISHES
2. GIMBAL SYSTEM-A&C AXIS CAN BE OPERATED BY MDC 2 POSITION CONTROLS. A&C OR A&B AXIS ARE USED IN THE AUTO TRACK MODE. THE B-AXIS IS HELD AT ZERO IN MANUAL MODE. IN AUTO MODE THE B-AXIS ALLOWS TRACK THRU THE ZENITH POLE.
C - AXIS (+125°-4°)
B - AXIS (±23.5°)
A - AXIS (360° ROTATION)
BEAMWIDTH CONTROLS
ANTENNA CONTROLS
TRACK
BEAMWIDTH
UPLINK LOCK STATUS
ANTENNA SYSTEM LOGIC OPERATION
ACQ MODE
TRACK/RCV MODE
XMT MODE
WARNING LIGHT AND C&W TONE
RF SCAN LIMIT LOGIC
RF LOBING
PITCH AND YAW POSITION CONTROLS
MAN
AUTO
REACQ
WIDE
MED
NARROW
NO EFFECT
LOCKED
UNLOCKED
SCAN LIMIT WARNING OPERATIVE IN WARNING ZONE (1)
INOPERATIVE
STOPS TRACKING AND SETS BREAKS AT SCAN LIMIT
STOPS TRACKING AND SWITCHES TO MANUAL AT SCAN LIMIT INHIBITS FINE TRACKING DURING ACQ IN SCAN LIMIT WARNING ZONE
OFF
ON
CONTROL ANT POSITION TO ANY POSITION WITHIN MECHANICAL LIMITS OF GIMBALS
DETERMINES ANT POSITION DURING NO-TRACK PERIODS IF SCAN LIMIT LOGIC IS SET (2)
(1) SCAN LIMIT WARNING ZONE BEGINS 15 ± 3 BEFORE RF SCAN LIMIT
(2) RE-ACQUISITION POSITION CAN BE INSIDE OR OUTSIDE THE SCAN LIMIT WARNING ZONE
50 HZ LOBING CONTROL
PWR TO AL HIGH GAIN ANTENNA CIRCUITS
SCAN LIMIT
MODE CONTROLS
RF LIMIT SIGNALS
STATOR
ROTOR
REF
LIMIT FUNCTION
COMMAND RESOLVER
READOUT RESOLVER
INDUCTION POT
GEAR BOX
3000:1
2000:1
1000:1
TACH
GIMBAL BEARING
C-AXIS
B-AXIS
A-AXIS
BOOM
SCALE FACTOR
MODE SWITCH
C-AXIS MANUAL
C-AXIS AUTO
B-AXIS AUTO
A-AXIS AUTO
A-AXIS MANUAL
B-AXIS
A-AXIS AUTO
WRAPAROUND
400 HZ
+5 VDC
YAW ANGLE
PITCH ANGLE
TRACKING SIGNAL DEMODULATOR AND 400 HZ MODULATOR
TRACKING ERROR-50
RF LOCKED/UNLOCKE
HIGH GAIN ANTENNA SERVO SYSTEM
PRIMARY/SECONDARY HIGH GAIN ANTENNA ELECTRONICS
(MOUNTED ON SM FWD BULKHEAD)
SERVICE MODULE AFT STRUCTURE


N
M
L
K
J
SM
CM
S-BAND OMNI ANTENNAS
CM AFT COMPARTM
AFT HEAT SHIELD FLUSH MOUNTED
C
B
A
D
75 D OMNI ANT SELECT
K16B
K16A
FROM S-BAND NORMAL XPNDR PRIM-OFF-SEC SWITCH
17
74 ANTENNA RESET
S-BAND ANTENNA SW
K5
K3
K2
K1
K4
S-BAND ANTENNA
OMNI
HI GAIN
MDC 3 S 40
MDC 3 C S 41
TRIPLEXER
RCV - PM
XMT - FM
XMT - PM
RF BYPAS
BYPASS OUT 1
3
PM-SEC TWT
K22R
K22S
K15R
K15S
RF SWITCHING MODULE
CIRCUIT UTILITY BOX
K2
AC PWR
DC PWR
HIGH GAIN ANTENNA
GROUP 2
2 A
RHEB 225 CB 6
FLT BUS
5A
RHEB 225 CB 5
21
AC PWR
NOT CONNECTED
PWR
STBY
OFF
MDC 2 S 76
HI GAIN ANT SCAN LIMIT
C & W TONE ACTIVATE
GSE
HIGH GAIN ANTENNA BEAMWIDTH
WIDE
MED
NARROW
MDC 2 S 90
HIGH GAIN ANTENNA
TRACK
AUTO
MAN
REACQ
MDC 2 S77
HIGH GAIN ANTENNA
SERVO ELEC
PRIM
SEC
MDC 2 S 83
HIGH GAIN ANTENNA
PITCH +90° POSITION
YAW 0° POSITION
18 S - BAND PM RCVR AGC (SIGNAL STRENGTH)
COMMAND RESOLVER
COMMAND RESOLVER
COMMAND RESOLVER
MDC 2
20
RF TRACK FROM S-BAND PM - RCVRS
MDC 2
DEG
PITCH
MDC 2
TUNE FOR MAX
S-BAND ANT
MDC 2
DEG
YAW
SEC TWT PWR MODULE
K3S
K3R
K9S
K9R
K4S
K4R
UNDERVOLT SENSE
SEC TWT POWER SUPPLY
HIGH
LOW
FILAMENT φA - φB
BYPASS OUT & FLAG INDICATION
15
FILAMENT AC COLLECTOR DC ANODE DC
TWT PWR
PM - PRIM TWT
PM - SEC TWT
16
BYPASS IN
PRIM TWT POWER SUPPLY
FILAMENT φA - φB
UNDERVOLT SENSE
K2R
K2S
K8S
K8R
PRIM TWT PWR MODULE
K1S
K1R
SM
CM
S-BAI


RCV - PM
XMT - FM
XMT - PM
6 DB ATTN
1 DB ATTN
9 DB ATTN
BYPASS IN
K14S
K14R
K13S
FM XMTR 2272.5 MHZ
SEC PM XMTR 2287.5 MHZ
PRIM PM XMTR 2287.5 MHZ
OUTPUT MATCHING NETWORK SWITCH
CT0640F USB RCVR PHASE ERR -90 TO +90 KHZ 10 S/S
CT0620E USB RCVR AGC VOLTAGE -130 TO -50 DBM 10 S/S 1 S/S
PRIM PM RCVR 2106.4 MHZ
SEC PM RCVR 2106.4 MHZ
INPUT MATCHING NETWORK SWITCH
FM XMTR PWR SUPPLY
PRIM PM XMTR & RCVR PWR SUPPLY
SEC PM XMTR & RCVR PWR SUPPLY
AC PWR
K3R (OFF)
K3S (ON)
K1S (ON)
K1R (OFF)
K2R (OFF)
K2S (ON)
S-BAND NORMAL PWR AMPL
PRIM
SEC
MDC 3 S 31
MDC 3 S 32
PWR AMPL
GRAY WHEN EITHER PWR AMPL IS SELECTED FOR PM OPERATION
S-BAND PWR AMPL PHASE MOD XPONDER FLT BUS 1 & FLT BUS 2 CIRCUIT BREAKERS
TV-OFF-SCI SWITCH 37
PRIM AC PWR
SEC AC PWR
K26B
K26A
K25A
HIGH
LOW
43,46 POWER AMP OFF
43,47 POWER AMP LOW
42,47 POWER AMP HIGH
42,46 POWER AMP RESET
90 SEC DELAY
90 SEC SECONDARY TWT FILAMENT WARMUP ELAPSE SIGNAL
WARMUP OVERRIDE
SEC PWR SUPPLY AC UNDERVOLT SENSE SIGNAL
60 MS HOLD
PWR SUPPLY HOLD OFF FOR TWT TRANSFER
PRIM PWR SUPPLY AC UNDERVOLT SENSE SIGNAL
90 SEC PRIM TWT FILAMENT WARMUP ELAPSE SIGNAL
SELECTS PRIM TWT FOR PM & SEC FOR FM
SELECTS SEC TWT FOR PM & PRIM FOR FM
RELAY & LOGIC PWR
(NOT USED)
FM LOW
FM HIGH
PM LOW
PM HIGH
SWITCHING LOGIC MODULE
WR AMPL EQUIPMENT
UNIFIED S-BAND EQUIP



2 S-BAND

SIGNATURES	DATE
DR	
DSGN	
QC	9-26-67
ENGR	9-12-67
NR	10-11-67
APP	10-11-67
FEC	
AUTH	11-7-67

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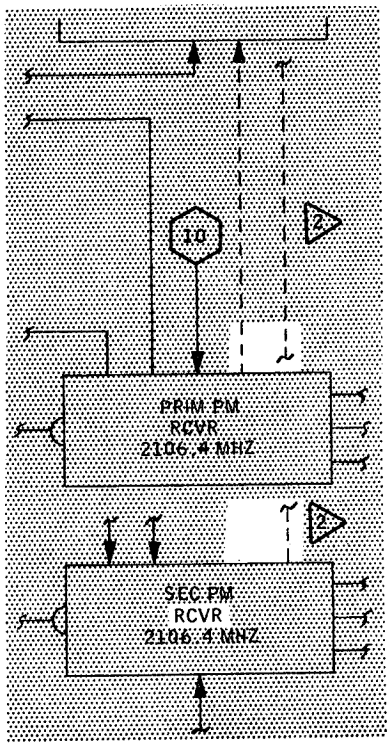
UNIFIED S-BAND SYSTEM RF EQUIPMENT

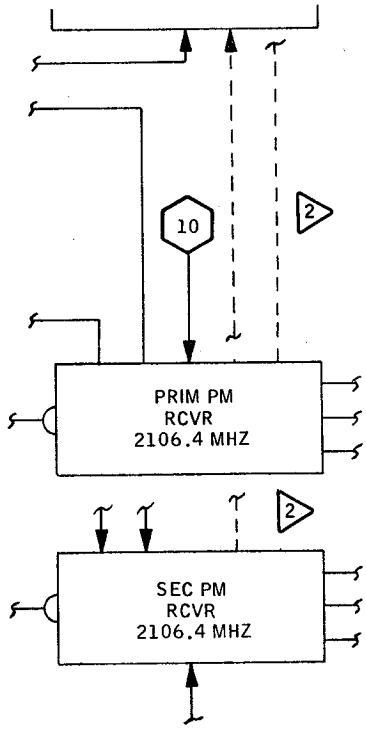
CSM 104 | SIZE J | DWG NO. 6.2 | 99 X 34 | PAGE | SHEET 1 of 1

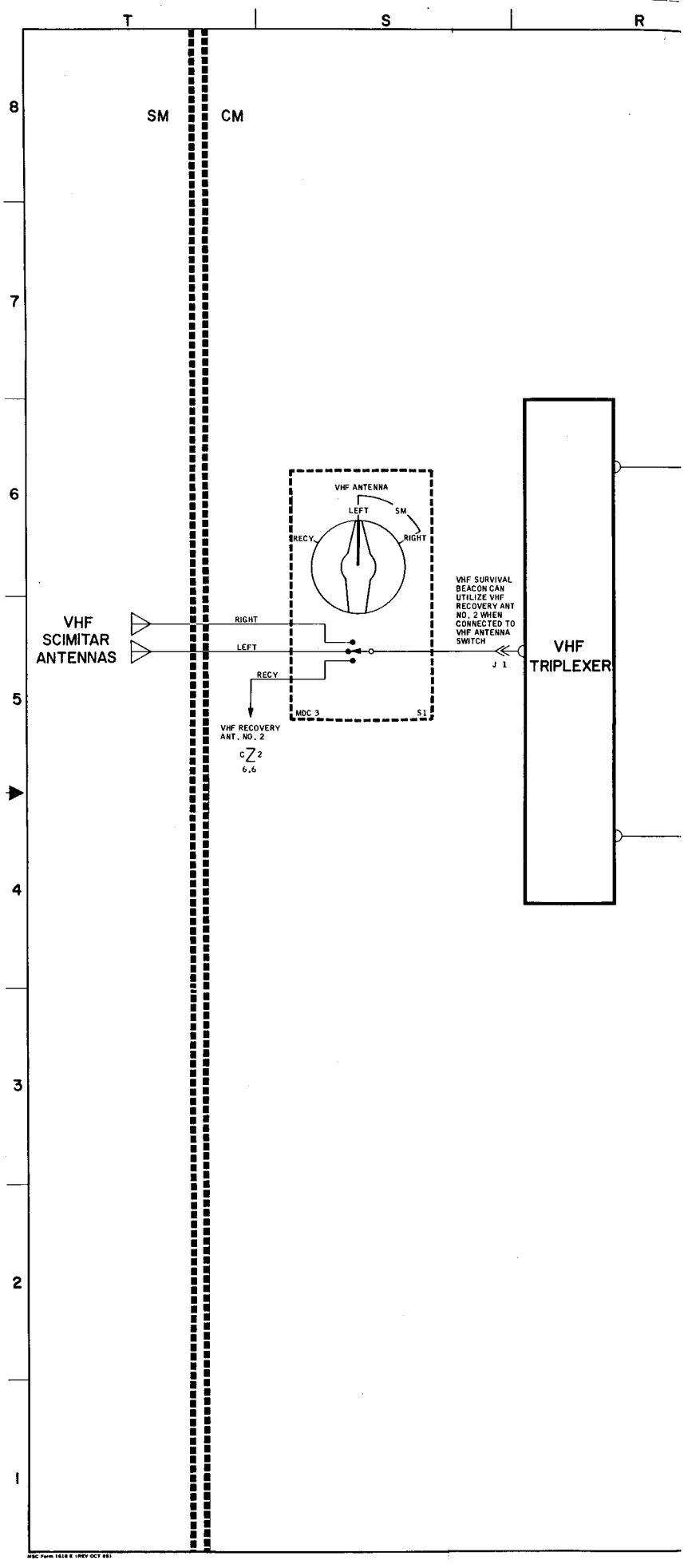
IS

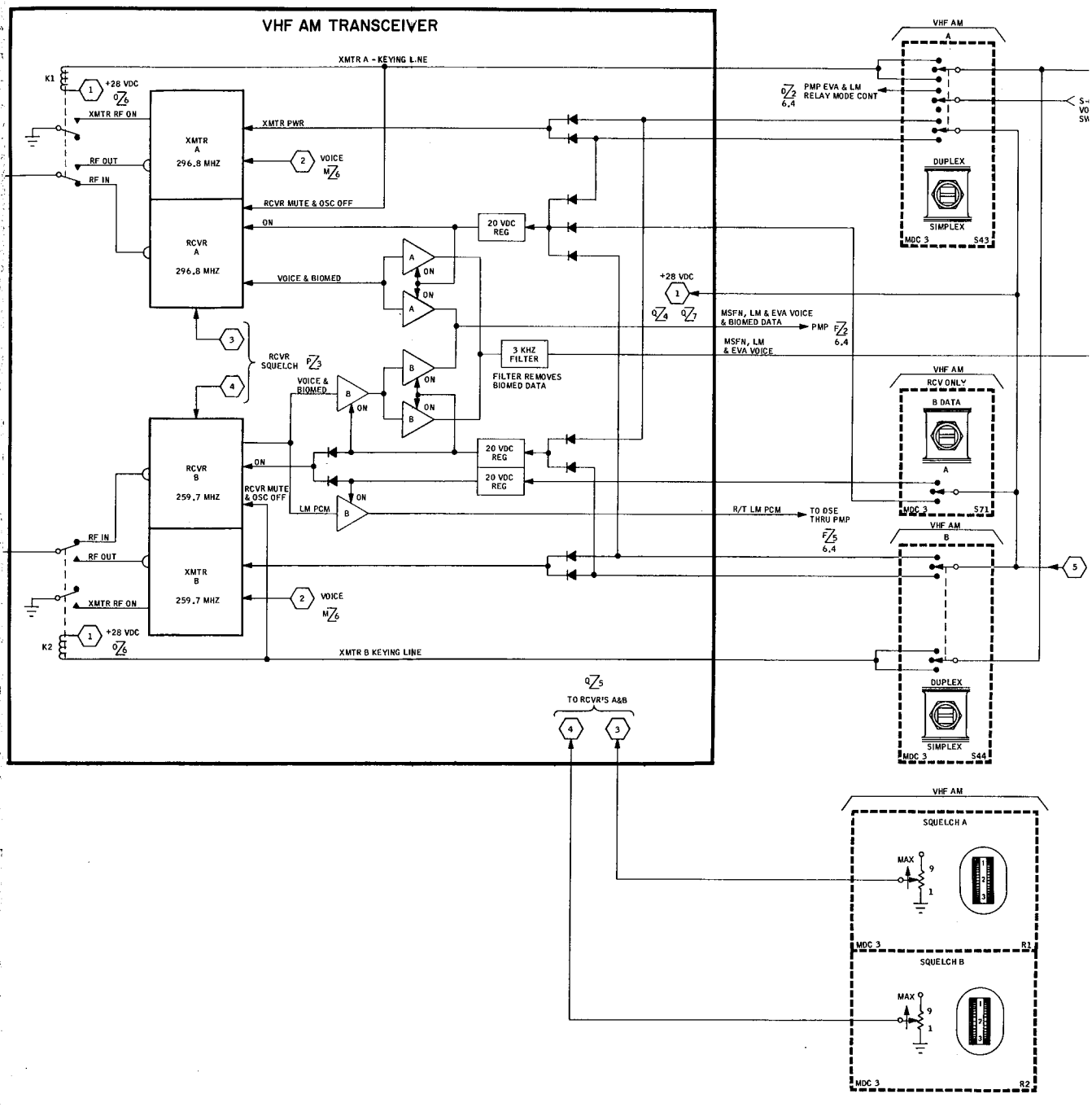
1. DWG 6.2 E Z 7,6,5

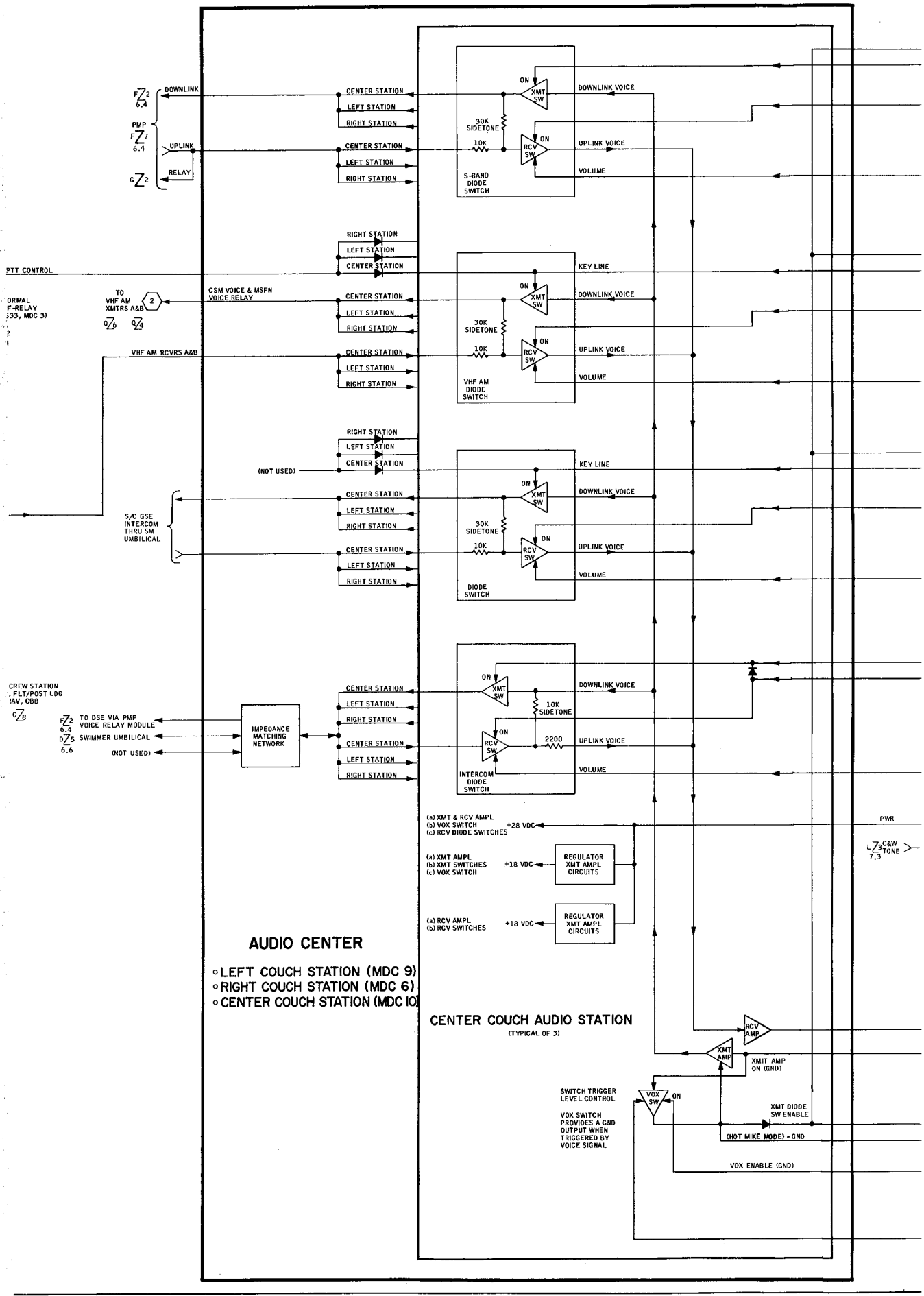


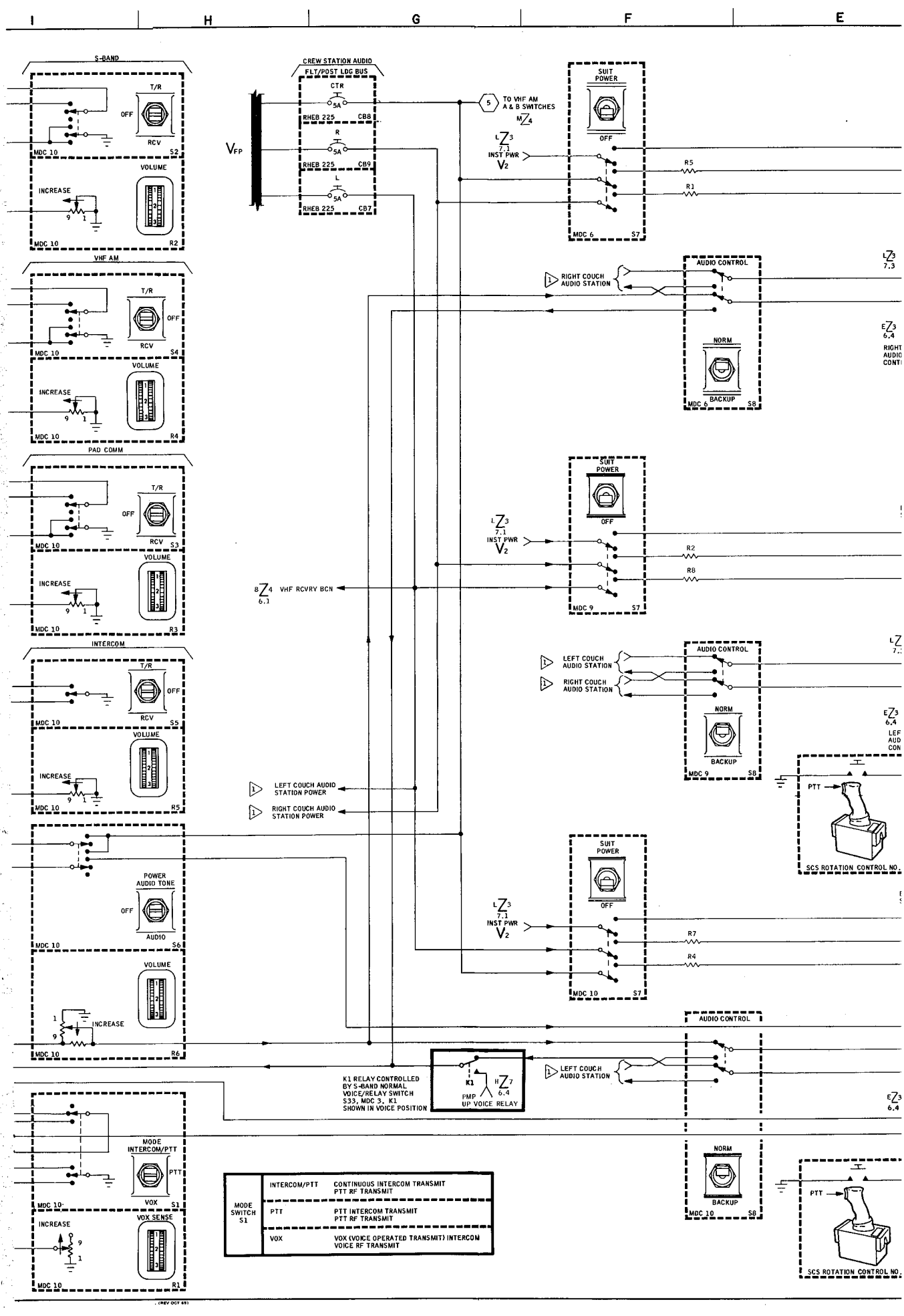
WAS

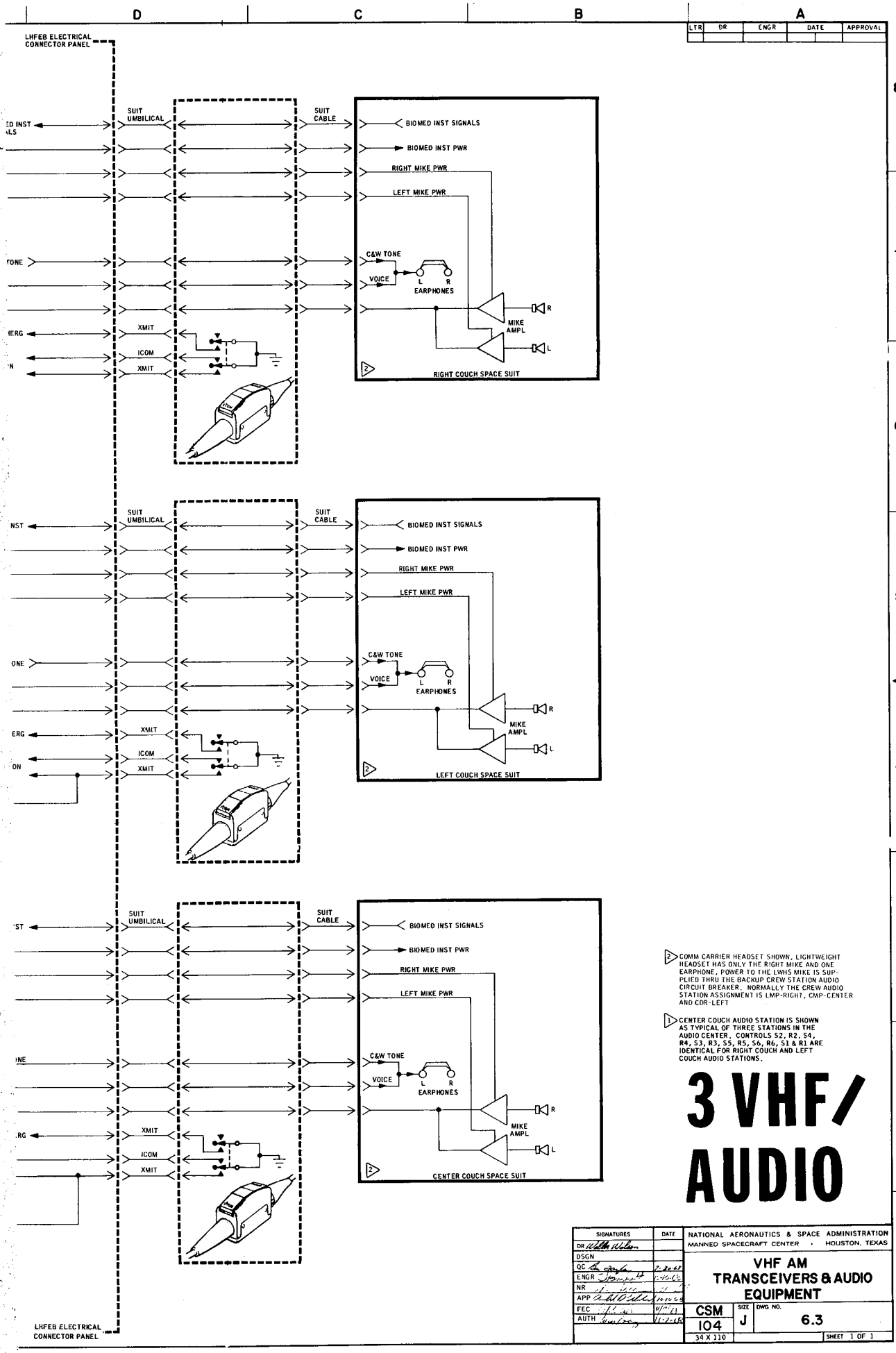



T
S
R
8
7
6
5
4
3
2
1
SM
CM
VHF ANTENNA
LEFT
SM
RIGHT
RECY
VHF SURVIVAL BEACON CAN UTILIZE VHF RECOVERY ANT NO. 2 WHEN CONNECTED TO VHF ANTENNA SWITCH
VHF SCIMITAR ANTENNAS
RIGHT
LEFT
RECY
J 1
VHF TRIPLEXER
MDC 3
S1
VHF RECOVERY ANT. NO. 2
CZ2
6.6


VHF AM TRANSCEIVER
XMTR A - KEYING LINE
K1
+28 VDC
XMTR RF ON
RF OUT
RF IN
XMTR A 296.8 MHZ
XMTR PWR
VOICE
RCVR MUTE & OSC OFF
ON
RCVR A 296.8 MHZ
20 VDC REG
VOICE & BIOMED
A
ON
RCVR SQUELCH
3 KHZ FILTER
FILTER REMOVES BIOMED DATA
B
RCVR B 259.7 MHZ
RCVR MUTE & OSC OFF
LM PCM
R/T LM PCM
TO DSE THRU PMP
XMTR B 259.7 MHZ
XMTR RF ON
K2
XMTR B KEYING LINE
TO RCVR'S A&B
PMP EVA & LM RELAY MODE CONT
MSFN, LM & EVA VOICE & BIOMED DATA
PMP
MSFN, LM & EVA VOICE
VHF AM A
DUPLEX
SIMPLEX
MDC 3 S43
VHF AM RCV ONLY
B DATA
MDC 3 S71
VHF AM B
DUPLEX
SIMPLEX
MDC 3 S44
VHF AM
SQUELCH A
MAX
MDC 3 R1
SQUELCH B
MDC 3 R2


M
L
K
J
DOWNLINK
UPLINK
RELAY
PMP
CENTER STATION
LEFT STATION
RIGHT STATION
ON
XMT SW
RCV SW
30K SIDETONE
10K
S-BAND DIODE SWITCH
DOWNLINK VOICE
UPLINK VOICE
VOLUME
PTT CONTROL
KEY LINE
CSM VOICE & MSFN VOICE RELAY
TO VHF AM XMTRS A&B
VHF AM RCVRS A&B
VHF AM DIODE SWITCH
(NOT USED)
S/C GSE INTERCOM THRU SM UMBILICAL
DIODE SWITCH
CREW STATION
FLT/POST LDG
IAV, CBB
TO DSE VIA PMP VOICE RELAY MODULE
SWIMMER UMBILICAL
IMPEDANCE MATCHING NETWORK
10K SIDETONE
2200
INTERCOM DIODE SWITCH
(a) XMT & RCV AMPL
(b) VOX SWITCH
(c) RCV DIODE SWITCHES
+28 VDC
PWR
(a) XMT AMPL
(b) XMT SWITCHES
(c) VOX SWITCH
+18 VDC
REGULATOR XMT AMPL CIRCUITS
(a) RCV AMPL
(b) RCV SWITCHES
C&W TONE
AUDIO CENTER
LEFT COUCH STATION (MDC 9)
RIGHT COUCH STATION (MDC 6)
CENTER COUCH STATION (MDC 10)
CENTER COUCH AUDIO STATION
(TYPICAL OF 3)
RCV AMP
XMT AMP
XMIT AMP ON (GND)
SWITCH TRIGGER LEVEL CONTROL
VOX SW
VOX SWITCH PROVIDES A GND OUTPUT WHEN TRIGGERED BY VOICE SIGNAL
XMT DIODE SW ENABLE
(HOT MIKE MODE) - GND
VOX ENABLE (GND)


I
H
G
F
E
S-BAND
T/R
OFF
RCV
MDC 10
S2
VOLUME
INCREASE
R2
VHF AM
S4
R4
PAO COMM
S3
R3
INTERCOM
S5
R5
POWER
AUDIO TONE
AUDIO
S6
R6
MODE
INTERCOM/PTT
PTT
VOX
S1
VOX SENSE
R1
CREW STATION AUDIO
FLT/POST LDG BUS
CTR
5A
RHEB 225
CB8
R
CB9
L
CB7
VFP
TO VHF AM A & B SWITCHES
INST PWR
V2
SUIT POWER
MDC 6
S7
R5
R1
RIGHT COUCH AUDIO STATION
AUDIO CONTROL
NORM
BACKUP
S8
VHF RCVRY BCN
MDC 9
R2
R8
LEFT COUCH AUDIO STATION
R7
R4
LEFT COUCH AUDIO STATION POWER
RIGHT COUCH AUDIO STATION POWER
K1 RELAY CONTROLLED BY S-BAND NORMAL VOICE/RELAY SWITCH S33, MDC 3, K1 SHOWN IN VOICE POSITION
K1
PMP
UP VOICE RELAY
PTT
SCS ROTATION CONTROL NO.
MODE SWITCH S1
INTERCOM/PTT
CONTINUOUS INTERCOM TRANSMIT
PTT RF TRANSMIT
PTT
PTT INTERCOM TRANSMIT
PTT RF TRANSMIT
VOX
VOX (VOICE OPERATED TRANSMIT) INTERCOM
VOICE RF TRANSMIT



2 COMM CARRIER HEADSET SHOWN, LIGHTWEIGHT HEADSET HAS ONLY THE RIGHT MIKE AND ONE EARPHONE, POWER TO THE LWHS MIKE IS SUPPLIED THRU THE BACKUP CREW STATION AUDIO CIRCUIT BREAKER. NORMALLY THE CREW AUDIO STATION ASSIGNMENT IS LMP-RIGHT, CMP-CENTER AND CDR-LEFT

1 CENTER COUCH AUDIO STATION IS SHOWN AS TYPICAL OF THREE STATIONS IN THE AUDIO CENTER. CONTROLS S2, R2, S4, R4, S3, R3, S5, R5, S6, R6, S1 & R1 ARE IDENTICAL FOR RIGHT COUCH AND LEFT COUCH AUDIO STATIONS.

3 VHF/ AUDIO

SIGNATURES	DATE
DR	
DSGN	
QC	2-20-67
ENGR	1-11-67
NR	
APP	10/10/66
FEC	11/11/66
AUTH	11-2-66

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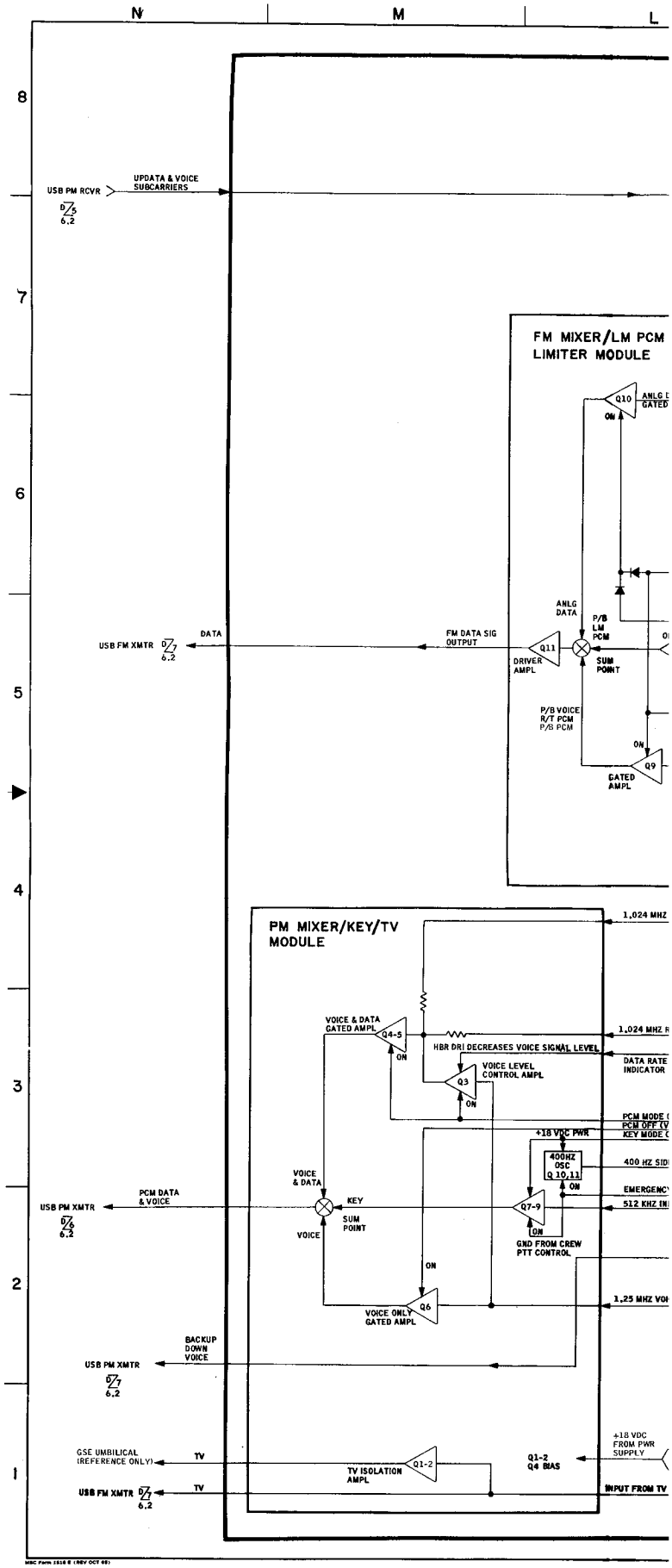
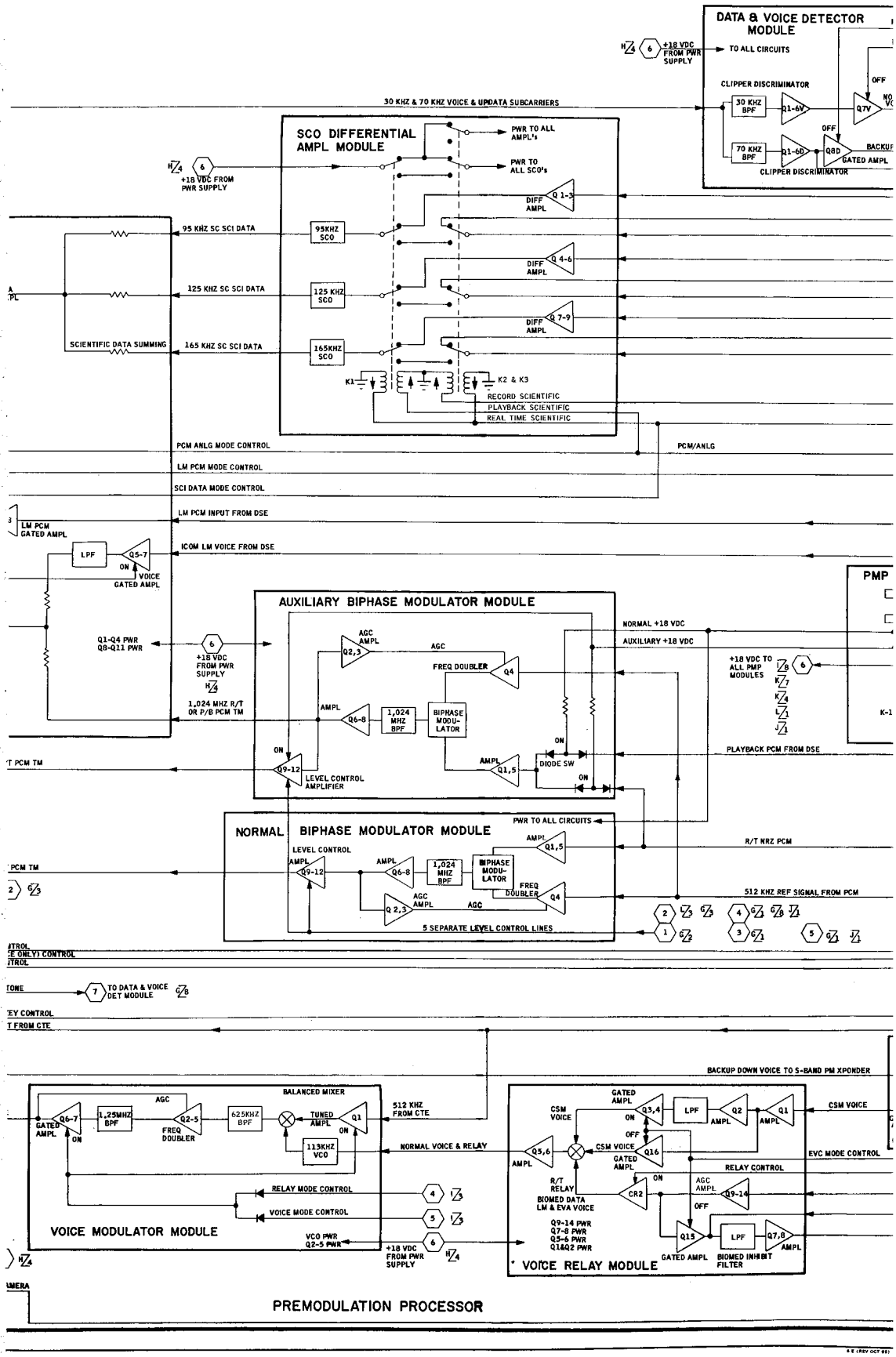
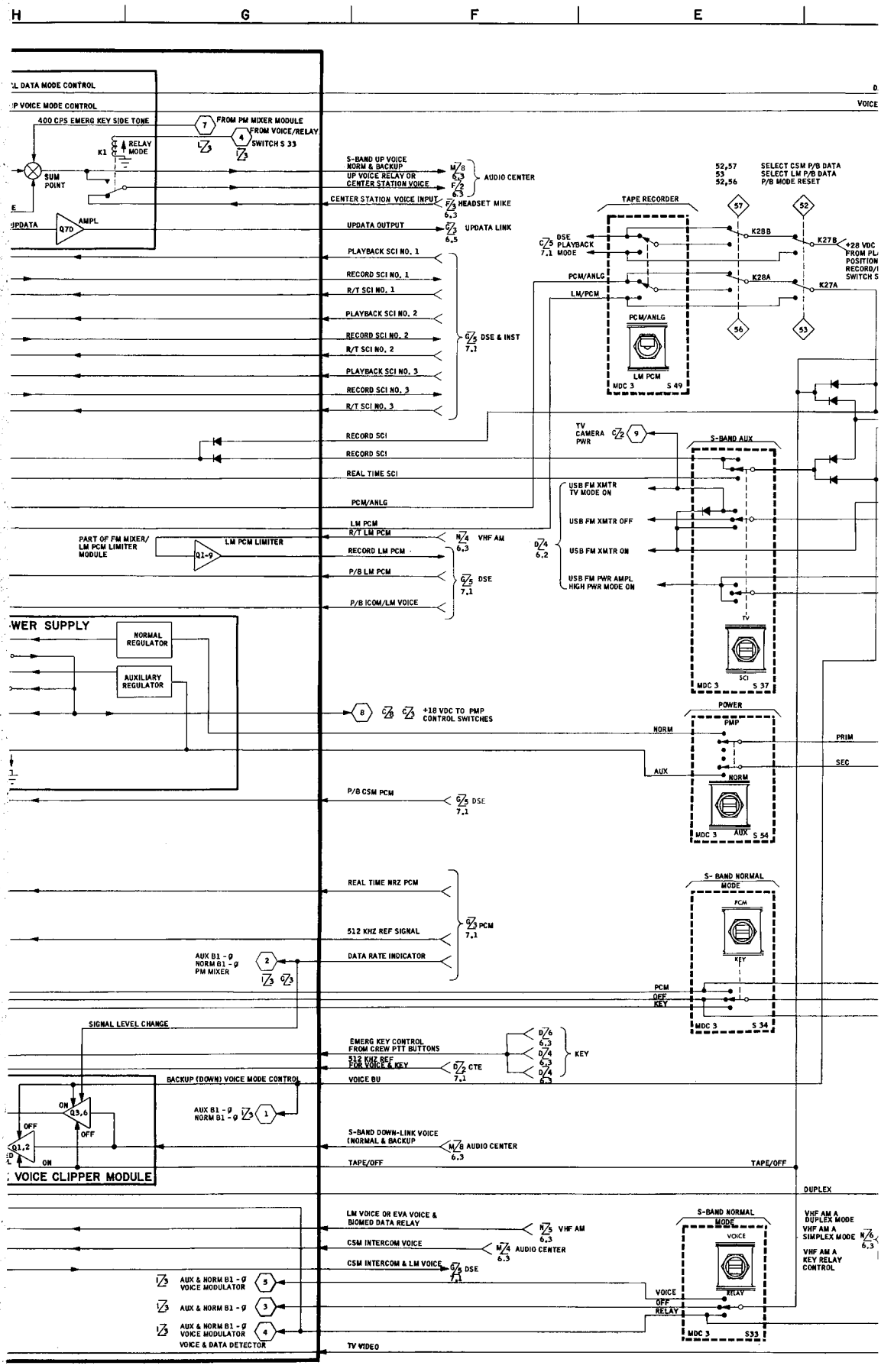
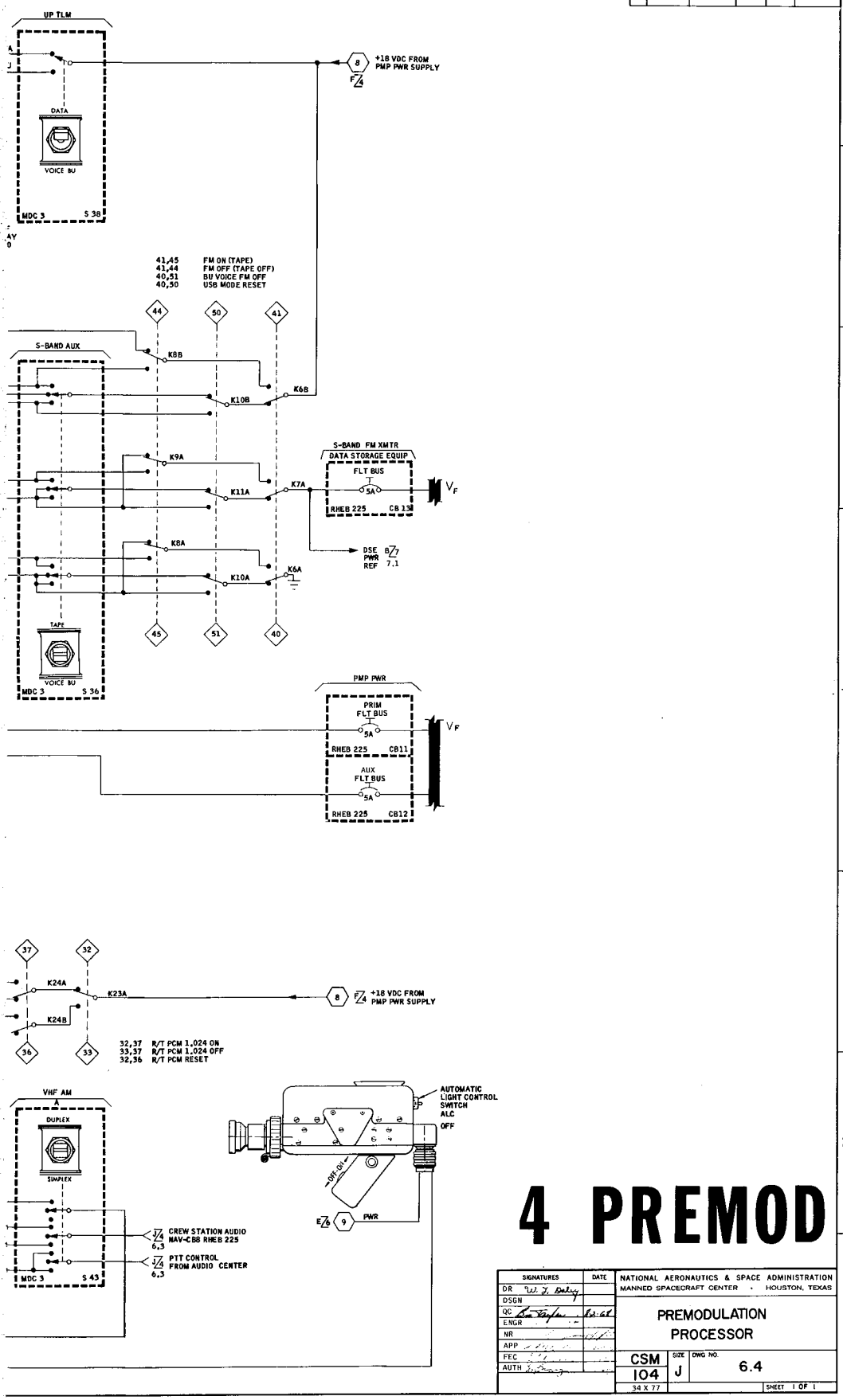
VHF AM TRANSCEIVERS & AUDIO EQUIPMENT

CSM	SIZE	DWG NO.
104	J	6.3
34 X 110		SHEET 1 OF 1


N
M
L
8
7
6
5
4
3
2
1
USB PM RCVR
UPDATA & VOICE SUBCARRIERS
6.2
FM MIXER/LM PCM LIMITER MODULE
Q10
ON
ANLG DATA
P/B LM PCM
SUM POINT
USB FM XMTR
DATA
FM DATA SIG OUTPUT
Q11
DRIVER AMPL
P/B VOICE R/T PCM P/B PCM
Q9
GATED AMPL
PM MIXER/KEY/TV MODULE
1.024 MHZ
VOICE & DATA GATED AMPL
Q4-5
HBR DR DECREASES VOICE SIGNAL LEVEL
DATA RATE INDICATOR
Q3
VOICE LEVEL CONTROL AMPL
+18 VDC PWR
400HZ OSC Q 10,11
VOICE & DATA
KEY
SUM POINT
VOICE
USB PM XMTR
PCM DATA & VOICE
Q7-9
GND FROM CREW PTT CONTROL
Q6
VOICE ONLY GATED AMPL
1.25 MHZ VOI
BACKUP DOWN VOICE
USB PM XMTR
GSE UMBILICAL (REFERENCE ONLY)
TV
TV ISOLATION AMPL
Q1-2
Q1-2 Q4 BIAS
+18 VDC FROM PWR SUPPLY
USB FM XMTR
INPUT FROM TV


DATA & VOICE DETECTOR MODULE
+18 VDC FROM PWR SUPPLY
TO ALL CIRCUITS
CLIPPER DISCRIMINATOR
30 KHZ BPF
70 KHZ BPF
Q1-6V
Q1-6D
Q7V
Q8D
OFF
GATED AMPL
30 KHZ & 70 KHZ VOICE & UPDATA SUBCARRIERS
SCO DIFFERENTIAL AMPL MODULE
PWR TO ALL AMPL's
PWR TO ALL SCO's
DIFF AMPL
Q 1-3
Q 4-6
Q 7-9
95 KHZ SC SCI DATA
125 KHZ SC SCI DATA
165 KHZ SC SCI DATA
SCIENTIFIC DATA SUMMING
95KHZ SCO
125 KHZ SCO
165KHZ SCO
K1
K2 & K3
RECORD SCIENTIFIC
PLAYBACK SCIENTIFIC
REAL TIME SCIENTIFIC
PCM ANLG MODE CONTROL
LM PCM MODE CONTROL
SCI DATA MODE CONTROL
PCM/ANLG
LM PCM INPUT FROM DSE
LM PCM GATED AMPL
ICOM LM VOICE FROM DSE
LPF
Q5-7
VOICE GATED AMPL
AUXILIARY BIPHASE MODULATOR MODULE
Q1-Q4 PWR
Q8-Q11 PWR
AGC AMPL
Q2,3
AGC
FREQ DOUBLER
Q4
1,024 MHZ R/T OR P/B PCM TM
AMPL
Q6-8
1,024 MHZ BPF
BIPHASE MODU-LATOR
Q9-12
LEVEL CONTROL AMPLIFIER
Q1,5
DIODE SW
NORMAL +18 VDC
AUXILIARY +18 VDC
+18 VDC TO ALL PMP MODULES
PLAYBACK PCM FROM DSE
PMP
NORMAL BIPHASE MODULATOR MODULE
PWR TO ALL CIRCUITS
LEVEL CONTROL
R/T NRZ PCM
512 KHZ REF SIGNAL FROM PCM
5 SEPARATE LEVEL CONTROL LINES
TONE
TO DATA & VOICE DET MODULE
T FROM CTE
BACKUP DOWN VOICE TO S-BAND PM XPONDER
BALANCED MIXER
GATED AMPL
1.25MHZ BPF
62.5KHZ BPF
TUNED AMPL
512 KHZ FROM CTE
113KHZ VCO
NORMAL VOICE & RELAY
RELAY MODE CONTROL
VOICE MODE CONTROL
VCO PWR Q2-5 PWR
+18 VDC FROM PWR SUPPLY
VOICE MODULATOR MODULE
CSM VOICE
Q3,4
Q2
Q1
Q5,6
Q16
R/T RELAY
BIOMED DATA LM & EVA VOICE
CR2
Q9-14
Q9-14 PWR
Q7-8 PWR
Q5-6 PWR
Q1&Q2 PWR
Q15
Q7,8
BIOMED INHIBIT FILTER
EVC MODE CONTROL
RELAY CONTROL
VOICE RELAY MODULE
PREMODULATION PROCESSOR


H
G
F
E
L DATA MODE CONTROL
P VOICE MODE CONTROL
VOICE
400 CPS EMERG KEY SIDE TONE
FROM PM MIXER MODULE
FROM VOICE/RELAY SWITCH S 33
RELAY MODE
K1
SUM POINT
AMPL
Q7D
UPDATA
S-BAND UP VOICE NORM & BACKUP
UP VOICE RELAY OR CENTER STATION VOICE
AUDIO CENTER
CENTER STATION VOICE INPUT
HEADSET MIKE
UPDATA OUTPUT
UPDATA LINK
PLAYBACK SCI NO. 1
RECORD SCI NO. 1
R/T SCI NO. 1
PLAYBACK SCI NO. 2
RECORD SCI NO. 2
R/T SCI NO. 2
PLAYBACK SCI NO. 3
RECORD SCI NO. 3
R/T SCI NO. 3
DSE & INST
52,57
53
52,56
SELECT CSM P/B DATA
SELECT LM P/B DATA
P/B MODE RESET
TAPE RECORDER
DSE PLAYBACK MODE
K28B
K27B
+28 VDC FROM PL
POSITION
RECORD/
SWITCH S
PCM/ANLG
K28A
K27A
LM/PCM
LM PCM
MDC 3
S 49
RECORD SCI
RECORD SCI
REAL TIME SCI
PCM/ANLG
TV CAMERA PWR
S-BAND AUX
USB FM XMTR TV MODE ON
USB FM XMTR OFF
USB FM XMTR ON
USB FM PWR AMPL HIGH PWR MODE ON
LM PCM R/T LM PCM
VHF AM
PART OF FM MIXER/ LM PCM LIMITER MODULE
LM PCM LIMITER
Q1-9
RECORD LM PCM
P/B LM PCM
P/B ICOM/LM VOICE
DSE
TV
SCI
MDC 3
S 37
WER SUPPLY
NORMAL REGULATOR
AUXILIARY REGULATOR
+18 VDC TO PMP CONTROL SWITCHES
POWER
PMP
NORM
PRIM
AUX
SEC
P/B CSM PCM
DSE
MDC 3
AUX
S 54
S- BAND NORMAL MODE
REAL TIME NRZ PCM
512 KHZ REF SIGNAL
DATA RATE INDICATOR
PCM
AUX B1 - 9 NORM B1 - 9 PM MIXER
PCM
KEY
MDC 3
S 34
PCM OFF KEY
SIGNAL LEVEL CHANGE
EMERG KEY CONTROL FROM CREW PTT BUTTONS
512 KHZ REF FOR VOICE & KEY
CTE
KEY
BACKUP (DOWN) VOICE MODE CONTROL
VOICE BU
ON
Q3,6
OFF
OFF
Q1,2
ON
AUX B1 - 9 NORM B1 - 9
S-BAND DOWN-LINK VOICE (NORMAL & BACKUP
AUDIO CENTER
TAPE/OFF
TAPE/OFF
VOICE CLIPPER MODULE
DUPLEX
LM VOICE OR EVA VOICE & BIOMED DATA RELAY
VHF AM
CSM INTERCOM VOICE
AUDIO CENTER
CSM INTERCOM & LM VOICE
DSE
S-BAND NORMAL MODE
VOICE
RELAY
VOICE OFF RELAY
MDC 3
S 33
VHF AM A DUPLEX MODE
VHF AM A SIMPLEX MODE
VHF AM A KEY RELAY CONTROL
AUX & NORM B1 - 9 VOICE MODULATOR
AUX & NORM B1 - 9
AUX & NORM B1 - 9 VOICE MODULATOR
VOICE & DATA DETECTOR
TV VIDEO



4 PREMOD

SIGNATURES	DATE
DR W. J. Daly	
DSGN	
QC Tom Taylor	12-6-67
ENGR	
NR	
APP	
FEC	
AUTH	

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PREMODULATION PROCESSOR

CSM	SIZE	DWG NO.
104	J	6.4

34 X 77 SHEET 1 OF 1

SECTION 6

IS

1. DWG 6.4 C,B Z 2

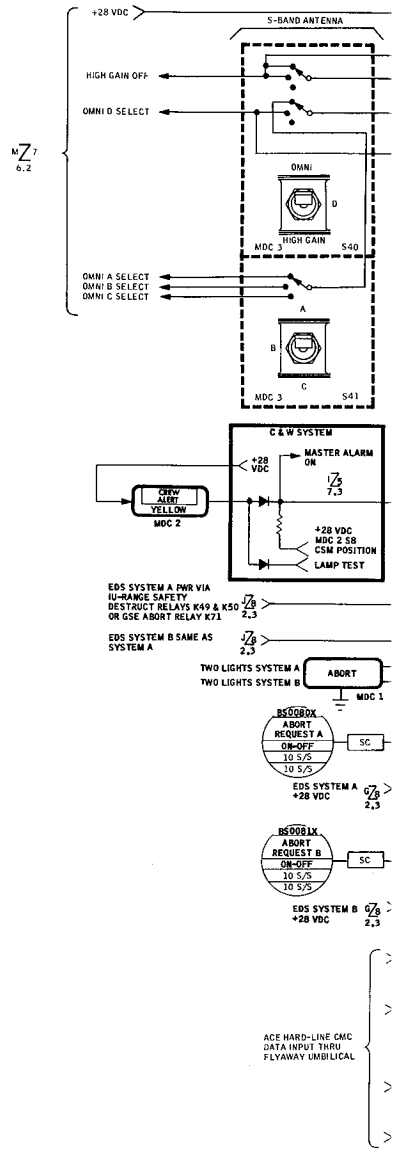
NO TV CAMERA ON CSM 104
(TV CAMERA LOCATED IN LM)

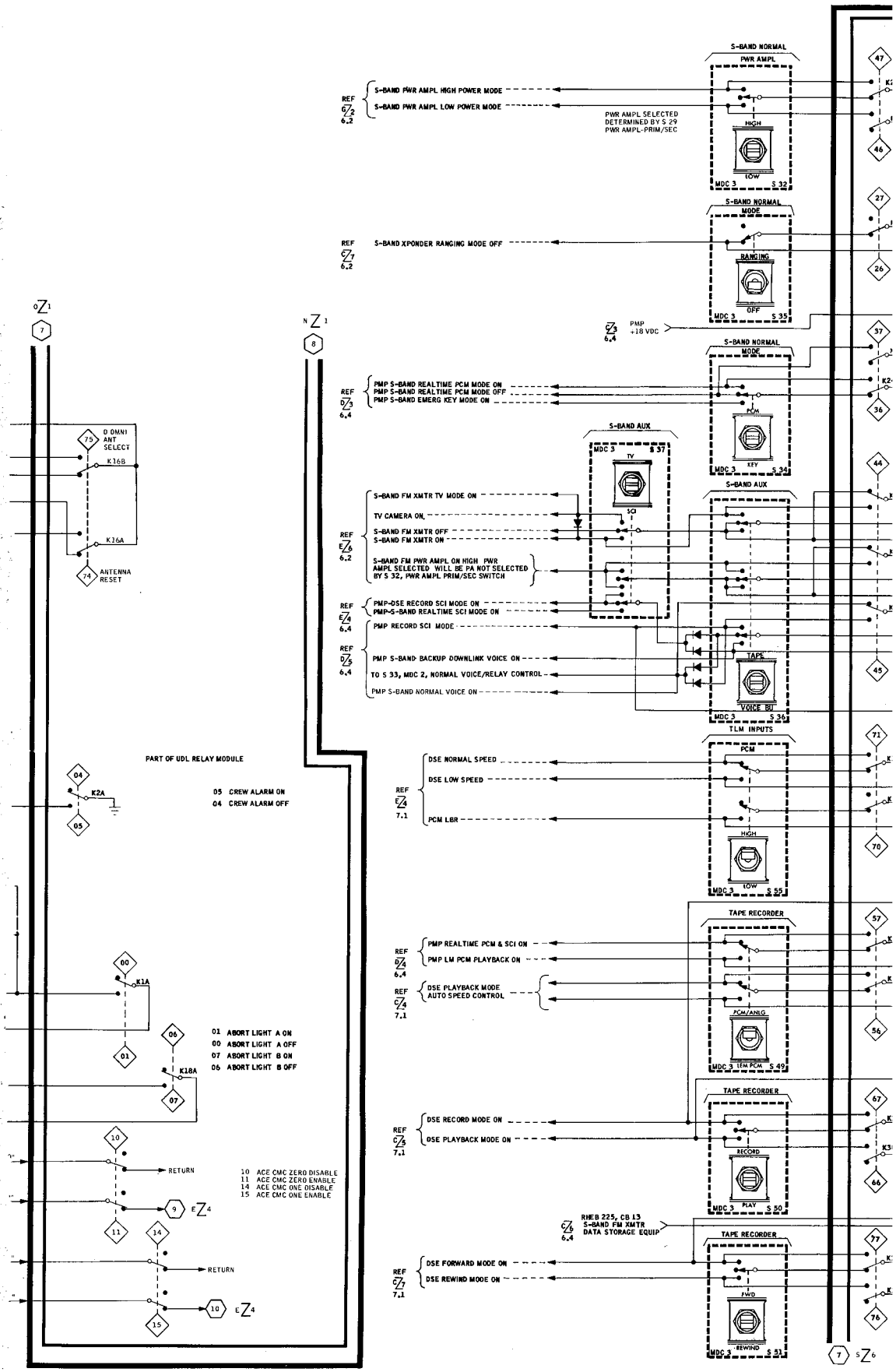
REALTIME COMMAND LIST

RTC (OCTAL) (46XX)	COMMAND FUNCTION	
00	ABORT LIGHT A OFF	S/3 6,5
01	ABORT LIGHT A ON	
02	(SPARE)	
03	(SPARE)	
04	CREW ALARM OFF	S/3 6,5
05	CREW ALARM ON	
06	ABORT LIGHT B OFF	S/3 6,5
07	ABORT LIGHT B ON	
10	ACE CMC ZERO DISABLE	
11	ACE CMC ZERO ENABLE	
12	(SPARE)	
13	(SPARE)	
14	ACE CMC ONE DISABLE	
15	ACE CMC ONE ENABLE	
16	(SPARE)	
17	(SPARE)	
20	(SPARE)	
21	(SPARE)	
22,26	RANGING RESET	O/7 6,5 C/7 6,2
22,27	RANGING ENABLE	
23	RANGING DISABLE	
24	(NOT USABLE)	
25	(NOT USABLE)	
30	(NOT USABLE)	
31	(NOT USABLE)	
32,36	R/T PCM RESET	O/6 6,5 O/3 6,4
32,37	R/T PCM 1,024 ON	
33,37	R/T PCM OFF	
34	(NOT USABLE)	
35	(NOT USABLE)	
40,50	USB MODE RESET	O/5 6,5 C/6 6,4
40,51	B/U VOICE FM OFF	
41,44	FM OFF (TAPE OFF)	
41,45	FM ON (TAPE)	
42,46	POWER AMP RESET	O/8 6,5 O/2 6,2
42,47	POWER AMP HIGH	
43,46	POWER AMP OFF	
43,47	POWER AMP LOW	
52,56	P/B MODE RESET	O/3 6,5 E/7 6,4 C/5 7,1
52,57	SELECT CSM P/B DATA	
53	SELECT LM P/B DATA	
54	(SPARE)	
55	(SPARE)	
60	(SPARE)	
61	(SPARE)	
62,66	DSE ELECT RESET	O/2 6,5 O/6 7,1
62,67	DSE ELECT RECORD	
63,66	DSE ELECT OFF	
63,67	DSE ELECT PLAYBACK	
64,70	BIT RATE RESET	O/4 6,5 E/4 7,1
64,71	BIT RATE HIGH	
65	BIT RATE LOW	
72,76	TAPE CNTL RESET	O/1 6,5 C/7 7,1
72,77	DSE TAPE FORWARD	
73,76	DSE TAPE STOP	
73,77	DSE TAPE REWIND	
74	ANTENNA RESET	
75	D OMNI ANT SELECT	

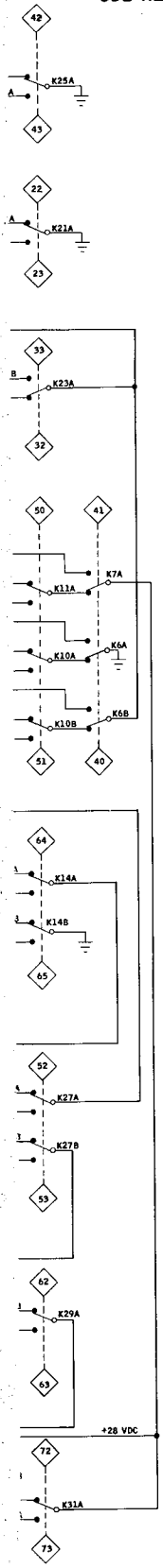
REALTIME COMMAND LIST

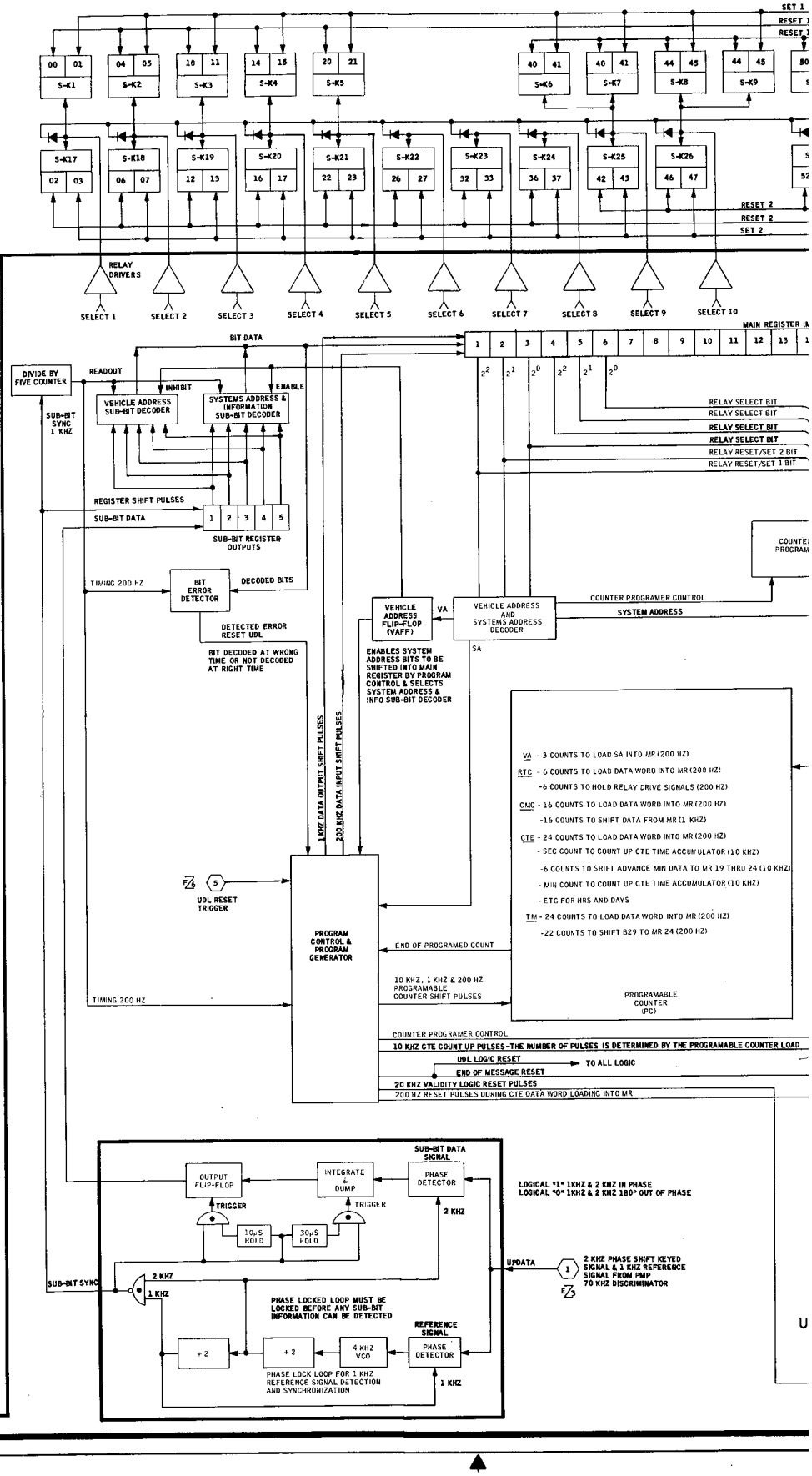
SALVO RESET (OCTAL) (45XX)	SALVO FUNCTION
30,32	SALVO RESET 1 (RESETS FOLLOWING RTC'S)
	00 ABORT LIGHT A OFF
	04 CREW ALARM OFF
	20 (NOT USED)
	10 ACE CMC ZERO DISABLE
	14 ACE CMC ONE DISABLE
	02,16 (NOT USED)
	06 ABORT LIGHT B OFF
	12 (NOT USED)
	22,26 RANGING RESET
	32,36 R/T PCM RESET
70,72	SALVO RESET 2 (RESETS FOLLOWING RTC'S)
	40,50 USB MODE RESET
	44,54,60 (NOT USED)
	64,70 BIT RATE RESET
	74 ANTENNA RESET
	42,46 POWER AMP RESET
	52,56 P/B MODE RESET
	62,66 DSE ELECT RESET
	72,76 TAPE CNTL RESET

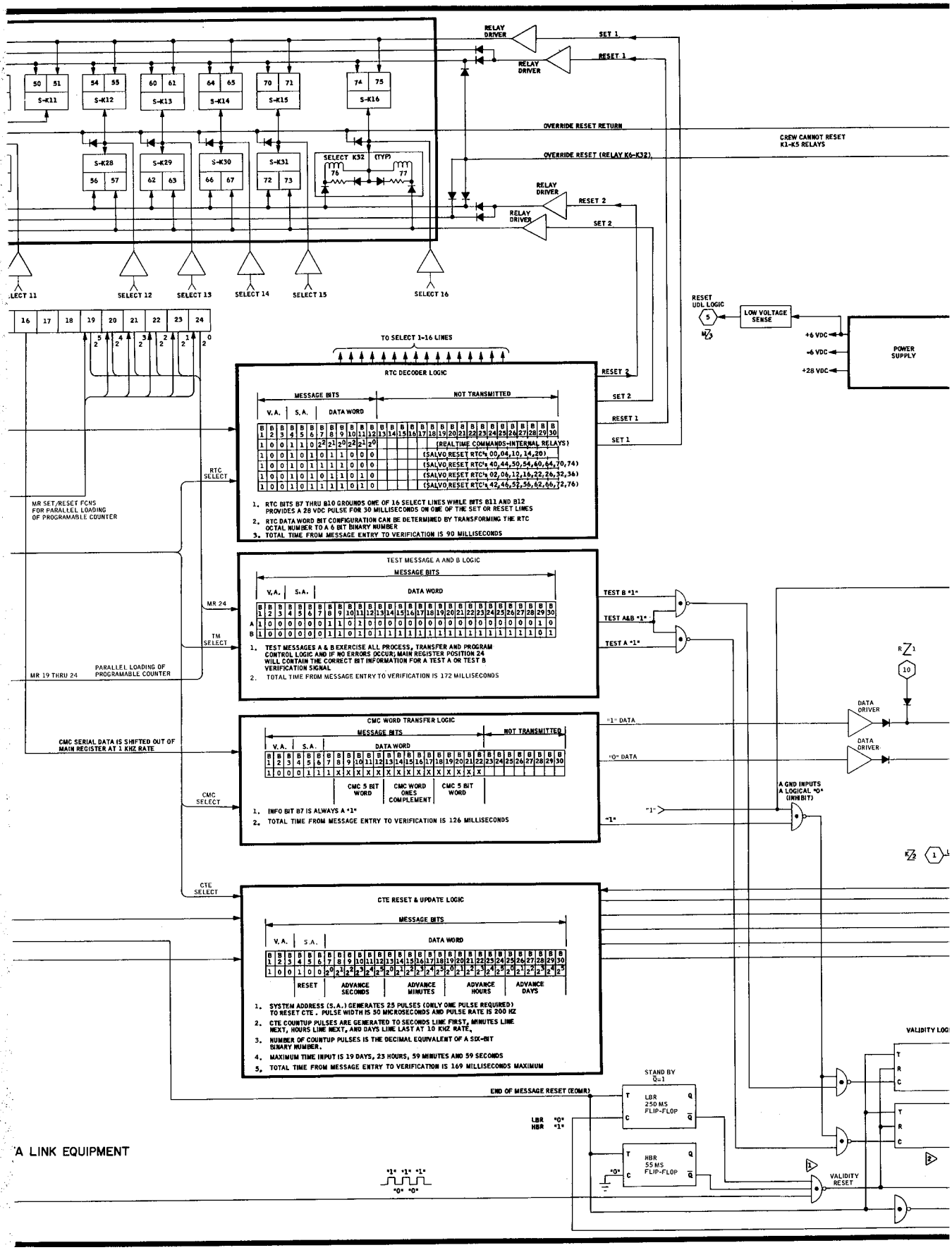



R
Q
P
O
S-BAND NORMAL
PWR AMPL
S-BAND PWR AMPL HIGH POWER MODE
S-BAND PWR AMPL LOW POWER MODE
PWR AMPL SELECTED DETERMINED BY S 29 PWR AMPL-PRIM/SEC
HIGH
LOW
MDC 3 S 32
S-BAND NORMAL MODE
S-BAND XPONDER RANGING MODE OFF
RANGING
OFF
MDC 3 S 35
PMP +18 VDC
S-BAND NORMAL MODE
PMP S-BAND REALTIME PCM MODE ON
PMP S-BAND REALTIME PCM MODE OFF
PMP S-BAND EMERG KEY MODE ON
PCM
KEY
MDC 3 S 34
S-BAND AUX
MDC 3 S 37
TV
SCI
S-BAND FM XMTR TV MODE ON
TV CAMERA ON
S-BAND FM XMTR OFF
S-BAND FM XMTR ON
S-BAND FM PWR AMPL ON HIGH PWR AMPL SELECTED WILL BE PA NOT SELECTED BY S 32, PWR AMPL PRIM/SEC SWITCH
PMP-DSE RECORD SCI MODE ON
PMP-S-BAND REALTIME SCI MODE ON
PMP RECORD SCI MODE
PMP S-BAND BACKUP DOWNLINK VOICE ON
TO S 33, MDC 2, NORMAL VOICE/RELAY CONTROL
PMP S-BAND NORMAL VOICE ON
TAPE
VOICE BU
MDC 3 S 36
TLM INPUTS
PCM
DSE NORMAL SPEED
DSE LOW SPEED
PCM LBR
HIGH
LOW
MDC 3 S 55
TAPE RECORDER
PMP REALTIME PCM & SCI ON
PMP LM PCM PLAYBACK ON
DSE PLAYBACK MODE AUTO SPEED CONTROL
PCM/ANLG
MDC 3 TEM PCM S 49
TAPE RECORDER
DSE RECORD MODE ON
DSE PLAYBACK MODE ON
RECORD
PLAY
MDC 3 S 50
RHEB 225, CB 13 S-BAND FM XMTR DATA STORAGE EQUIP
TAPE RECORDER
DSE FORWARD MODE ON
DSE REWIND MODE ON
FWD
REWIND
MDC 3 S 51
PART OF UDL RELAY MODULE
05 CREW ALARM ON
04 CREW ALARM OFF
K2A
01 ABORT LIGHT A ON
00 ABORT LIGHT A OFF
07 ABORT LIGHT B ON
06 ABORT LIGHT B OFF
K1A
K18A
10 ACE CMC ZERO DISABLE
11 ACE CMC ZERO ENABLE
14 ACE CMC ONE DISABLE
15 ACE CMC ONE ENABLE
RETURN
RETURN
OMNI ANT SELECT
K16B
K16A
ANTENNA RESET

UDL RELAY MODULE

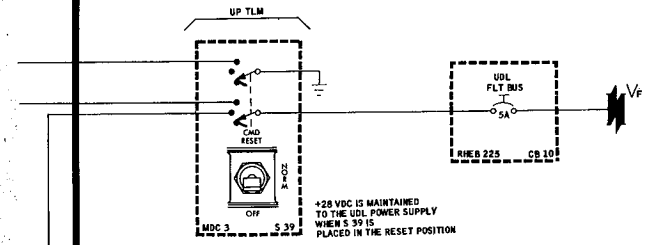


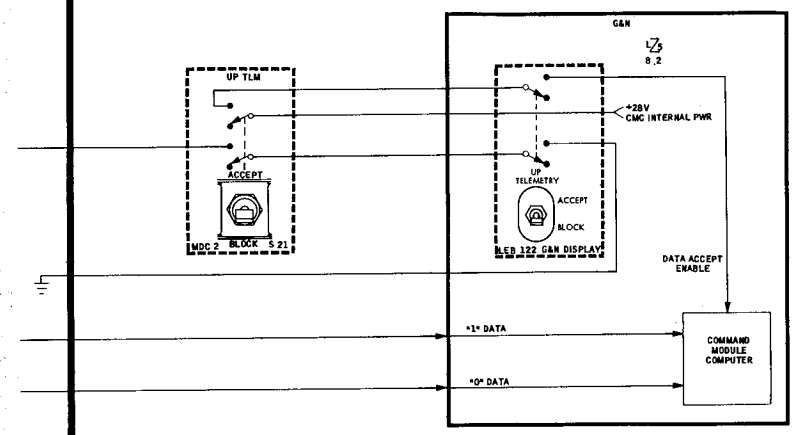


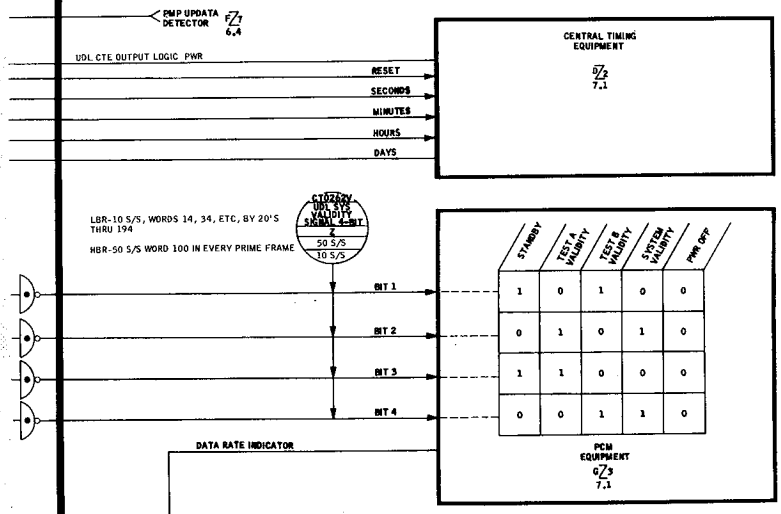


A LINK EQUIPMENT

LTR	DR	ENGR	DATE	APPROVAL







2 IF C = "0" THEN $\bar{Q}$ = "0" AND IF C = "1" THEN $\bar{Q}$ = "1" WHEN EOMR TRIGGERS T INPUT
IF Q = "0" THEN $\bar{Q}$ = "1" AND IF Q = "1" THEN Q = "0"

NOTES: 1 IN STANDBY $\bar{Q}$ = "1" ON BOTH FLIP-FLOPS AND VALIDITY LOGIC RESET SIGNAL CONTINUALLY RESETS VALIDITY LOGIC WITH EACH "0" TO "1" TRANSITION. DURING VALIDITY PERIOD WHEN EITHER $\bar{Q}$ = "0" THE RESET FUNCTION IS INHIBITED UNTIL THE FLIP-FLOP TIMES OUT.

5 UPDATA

SIGNATURES	DATE
DR	
DSGN	
QC	6-17-66
ENGR	10-6-65
NR	11/2/65
APP	10-10-65
FEC	11/1/65
AUTH	11-7-65

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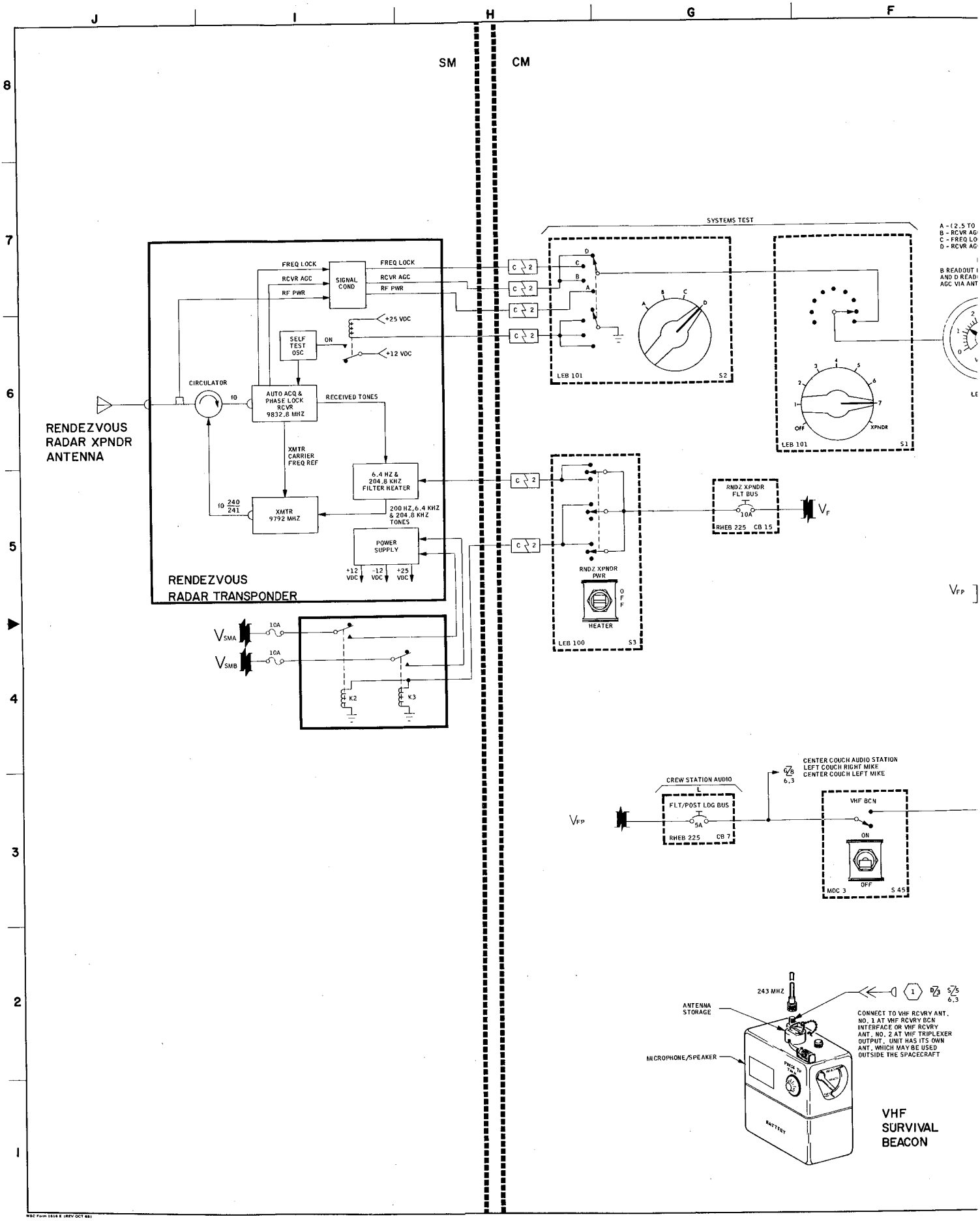
UP-DATA LINK

CSM 104 | SIZE J | DWG NO. 6.5 | 34 X 121 | SHEET 1 OF 1


J
I
H
G
F
SM
CM
8
7
6
5
4
3
2
1
RENDEZVOUS RADAR XPNDR ANTENNA
CIRCULATOR
f0
AUTO ACQ & PHASE LOCK RCVR 9832.8 MHZ
RECEIVED TONES
FREQ LOCK
RCVR AGC
RF PWR
SIGNAL COND
SELF TEST OSC
ON
+25 VDC
+12 VDC
XMTR CARRIER FREQ REF
6.4 HZ & 204.8 KHZ FILTER HEATER
f0 240/241
XMTR 9792 MHZ
200 HZ, 6.4 KHZ & 204.8 KHZ TONES
POWER SUPPLY
+12 VDC
-12 VDC
+25 VDC
RENDEZVOUS RADAR TRANSPONDER
C 2
SYSTEMS TEST
LEB 101
S2
LEB 101
S1
OFF
XPNDR
RNDZ XPNDR FLT BUS
10A
RHEB 225 CB 15
V_F
RNDZ XPNDR PWR
O F F
HEATER
LEB 100
S3
V_{FP}
V_{SMA}
V_{SMB}
10A
10A
K2
K3
CREW STATION AUDIO
L
FLT/POST LOG BUS
5A
RHEB 225 CB 7
CENTER COUCH AUDIO STATION
LEFT COUCH RIGHT MIKE
CENTER COUCH LEFT MIKE
6,3
VHF BCN
ON
OFF
MDC 3
S 45
243 MHZ
ANTENNA STORAGE
MICROPHONE/SPEAKER
CONNECT TO VHF RCVRY ANT. NO. 1 AT VHF RCVRY BCN INTERFACE OR VHF RCVRY ANT. NO. 2 AT VHF TRIPLEXER OUTPUT. UNIT HAS ITS OWN ANT. WHICH MAY BE USED OUTSIDE THE SPACECRAFT
BATTERY
VHF SURVIVAL BEACON

LTR	ENGR		DATE	APPROVAL

CM

CM FORWARD COMPARTMENT

TIED TO MAIN PARACHUTE RISERS

BEACON LIGHT DEPLOY INITIATE LINE

WHITE

8 SECOND DELAY PYRO ACTUATED DEPLOY MECHANISM

POST LANDING

BCN LT HI

BCN LT LO

MDC 15 S3

BEACON LIGHT POWER SUPPLY

BEACON LIGHT TRIGGER UNIT

	LO	HI
FLASH DURATION	10 μS	5 μS
FLASH RATE	15/MIN	120/MIN
INTENSITY	1.2 CANDLE SEC	1.0 CANDLE SEC

SWIMMER UMBILICAL & DYE MARKER ASSEMBLY

SWIMMER UMBILICAL DEPLOYS WITH DYE MARKER TO A LENGTH OF 8 FEET, DYE MARKER LIFE IS 12 HOURS NOMINAL

AUDIO CENTER M Z4 6.3

SWIMMER UMBILICAL (COILED)

YELLOW GREEN DYE MARKER

TO S 6, MDC 8 FLOAT BAG FILL-OFF-VENT SWITCH G Z3 2.6

FLOAT BAG 3

FLT/PL 5A

MDC 8 CB 8

POST LANDING

DYE MARKER

MDC 15 S2

ELECTRO MECHANICAL DEPLOY MECHANISM (18 TO 30 VDC OPERATING VOLTAGE)

VHF RECOVERY BEACON

POWER SUPPLY

FLIP FLOP

XMTR CONTROL 2 SEC ON - 3 SEC OFF

XMTR 243 MHZ

1 KHZ OSC

SQUARE WAVE MODULATION

1 F Z2 J2

RCVRY ANT. NO. 1

ANT. DEPLOY INITIATE LINE

TIED TO PARACHUTE RISERS

8 SEC DELAY PYRO ACTUATED DEPLOY MECHANISMS

TIED TO PARACHUTE RISERS

ANT. DEPLOY INITIATE LINE

FROM VHF ANT. SWITCH S Z5 6.3

RCVRY ANT. NO. 2

6 RECOVERY

SIGNATURES	DATE
DR Jack Foster	
DSGN	
QC	
ENGR J. Thurgate III	10/16/63
NR [illegible]	10/10/63
APP [illegible]	[illegible]
FEC [illegible]	11-7-63
AUTH [illegible]	11-7-63

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RENDEZVOUS TRANSPONDER AND RECOVERY EQUIPMENT

CSM 104 | SIZE J | DWG NO. 6.6 | SHEET 1 of 1

34 X 55

SECTION 6

IS

1. DWG 6.6 F,E Z7

A - (2.1 TO 5 VDC)
B - RCVR AGC (0 TO 4.5 VDC)
C - FREQ LOCK (4 TO 5 VDC, OPERATE MODE & LOCKED)

WAS

A - (2.5 TO 5 VDC)
B - RCVR AGC (0 TO 4.5 VDC)
C - FREQ LOCK (4.5 VDC)
D - RCVR AGC (0 TO 4.5 VDC)

NOTE

B READOUT IS TEST AGC
AND D READOUT IS RECEIVED
AGC VIA ANTENNA

TABLE 6-I.- UNIFIED S-BAND TRANSPONDER AND FM TRANSMITTER

ITEM	FUNCTION and/or PARAMETERS
1. Weight	32 pounds
2. Cooling	ECS Primary and/or Secondary Glycol Loops
3. Electrical Power	
a. DC Voltage	28 ± 4 Vdc (For control only)
b. AC Voltage	115 Vac, 400 Hz, 3 Phase
c. Power	
(1) PM Transponder	1.0 Watts DC (During ON/OFF Switching) 16.5 Watts AC (Prim or Sec)
(2) FM Transmitter	1.5 Watt DC (During ON/OFF Switching) 6.7 Watts AC
4. Activation Time	1 minute maximum - PM Receiver, PM Transmitter, and FM Transmitter
5. PM Receiver (Prim/Sec)	
a. Type	Double Conversion Superheterodyne, Phase Lock Loop
b. b. Frequency (Center)	2106.40625 MHz
c. Phase Lock Tracking Loop	
(1) In-Lock Range	±90 kHz for RF INPUT greater than -114 dbm and STATIC PHASE ERROR less than 15 degrees peak.
(2) In-Lock Rate	Linear rate of 35 kHz/second or less to ±90 kHz for RF INPUT greater than -114 dbm.
(3) Acquisition Probability	90 percent probability of acquisition on first sweep at above range and rates.
(4) Predetection Noise Bandwidth	16 kHz
(5) Loop Noise Bandwidth (Optimizing Point)	800 Hz (0 db S/N @ -134.5 dbm)
(6) Threshold	-125 dbm, defined as level of unmodulated CW signal below which lock cannot be maintained for period of at least one minute with 90 percent probability.
(7) Phase Error	24 degrees maximum (Offset + Rate Errors)
d. Dynamic Range	-51 dbm to -124 dbm (Normal) -35 dbm to -51 dbm (Must Maintain Lock and Must Not Damage Rcvr

TABLE 6-I.- UNIFIED S-BAND TRANSPONDER AND FM TRANSMITTER - Continued

ITEM	FUNCTION and/or PARAMETERS
e. Automatic Gain Control (AGC)	
(1) Attack Time	TBD
(2) Decay	TBD
f. Ranging Channel	
(1) Modulation	PM on Carrier
(2) Bandwidth	10 kHz to 1.5 MHz (3 db)
(3) PRN Bit Rate	992.834 kbs
(4) PRN Clock	992.834 kbs (496.417 kHZ Squarewave)
(5) PRN Code Length	5,456,602 bits (Lunar Code)
g. High-Gain Antenna Track Channel	
(1) Pointing Error Signal	50 Hz amplitude modulated signal derived from the coherent AGC detector.
(2) Earth Presence Signal	DC signal superimpose on pointing error signal when RCVR is locked to incoming RF signal.
h. Outputs	(See Table 6-IV Modes)
6. PM Transmitter (Prim/Sec)	
a. Type	PM, S-Band
b. Frequency	2287.5 MHz (Aux OSC Mode) or 240/221 times RCVR frequency when RCVR is phase locked to uplink RF signal. (See Auto OSC Control)
c. RF Output Power	301 to 374 milliwatts (Test Data)
d. Auto OSC Control	XMTR frequency is derived from XMTR Aux OSC prior to acquisition and RCVR VCO after acquisition. Switching is controlled using RCVR AGC signal.
(1) Aux OSC to RCVR VCO Switching Time	Less than 0.25 seconds
(2) RCVR VCO to Aux OSC Switching Time	Less than 6 seconds (3 Seconds Nominal at -51 dbm)

*

TABLE 6-I.- UNIFIED S-BAND TRANSPONDER AND FM TRANSMITTER - Concluded

ITEM	FUNCTION and/or PARAMETERS
(3) Switching Threshold	-127 dbm
e. Inputs	(See Table 6-III Modes)
7. FM Transmitter	
a. Type	FM, S-Band
b. Frequency	2272.5 MHz
c. RF Output	111 to 138 milliwatts (Test Data)
d. Inputs	(See Table 6-III Modes)
8. Special Operating Instructions	When switching between primary and secondary transponders, momentarily stop at the OFF (Center) position to allow control relays to operate.

*

TABLE 6-II.- S-BAND POWER AMPLIFIER

ITEM	FUNCTION and/or PARAMETERS
1. Weight	32 pounds maximum
2. Cooling	ECS Primary and/or Secondary Glycol Loop
3. Electrical Power	
a. Input Voltage	28 ± 4 Vdc control 115 Vac, 400 Hz, 3Ø
b. Input Power	
(1) Control Power	5 Watts maximum steady state and 350 Watts during switching for 0.5 seconds maximum.
(2) AC Power	High Pwr Ampl Mode 81 Watts Low Pwr Ampl Mode 32 Watts Off/Bypass 0 Watts Sum ac power values to obtain simultaneous power level operation of Prim and Sec power amplifiers.
4. Power Amplification Activation Time	No RF amplification until 90 second nominal filament warm-up period complete. RF transfer (PM or FM) from one power amplifier to the other, with a 60 millisecond RF amplification dropout, is possible without an additional 90 second delay (filament warm-up) if the desired power amplifier is operating at the time of transfer.
5. RF Output	
a. PM Output - Prim or Sec Power Amplifier	High Pwr Mode: 11.2 Watts min Low Pwr Mode: 2.8 Watts min Bypass Mode: Less than 2.5 db below input
b. FM Output - Prim or Sec Power Amplifier	High Pwr Mode: 11.2 Watts min
6. RF Input	
a. PM	275 to 400 milliwatts
b. FM	100 to 145 milliwatts (For rated output)

TABLE 6-II.- S-BAND POWER AMPLIFIER - Concluded

ITEM	FUNCTION and/or PARAMETERS
7. Under Voltage Protection	Under voltage protection circuit will remove ac pwr from power amplifier TWT if any phase of the ac input voltage falls below 95 Vac for 15 milliseconds or more. If this condition exists for 1 second or more a 90 second filament warm-up delay will occur when ac voltage is restored.
8. Special Operating Instructions	DC power should be applied before ac power and removed after ac power removal to prevent possible damage.

TABLE 6-III.- S-BAND DOW

	MODE NUMBER	1	2	3	4	5	6	7
PM DOWNLINK MODES AVAILABLE	Channels Included	Carrier Voice (a)	Carrier Voice (a)	Carrier Voice (a)	Carrier Voice (a)	Carrier --	Carrier --	Carrier --
		51.2-kbps TM	51.2-kbps TM	1.6-kbps TM	1.6-kbps TM	1.6-kbps TM	--	--
		--	PRN	PRN	--	--	--	PRN
		--	--	--	--	--	Key	--
PM DOWNLINK MODULATION PROCESS	Modulation Schemes; Subcarrier Characteristics	PRN : PM directly on carrier (2287.5 MHz) Backup Voice : PM directly on carrier (2287.5 MHz) Normal Voice (a): FM/PM; 1.25-MHz subcarrier deviated ±7.5 kHz peak (±9 kHz pe TM : PCM/PSK/PM; 1.024-MHz subcarrier bi-phase modulated ±90° Key : AM/PM; 512 kHz, 100 percent AM						
	Peak Carrier Deviation-Radians ($\Delta\theta$)	PRN : (c) Normal Voice (a): 0.7 for modes 1, 2 1.2 for modes 3, 4, 11, 12 Backup Voice : 0.7 for mode 8, 14 1.2 for mode 10, 16 TM : 1.2 for modes 1, 2, 16 (51.2-kbps) and mode 8 (1.6-kbps) 0.7 for modes 3, 4 (1.6-kbps) 1.6 for modes 5, 9 (1.6-kbps) and modes 13, 15 (51.2-kbps) Key : 1.0						

	MODE NUMBER	1	2	3	4	5	
FM DOWNLINK MODES AVAILABLE	Channels Included	1:1 Playback of Recorded Voice, Recorded CSM 51.2-kbps TM and Scientific Data (d)	32:1 Playback of Recorded Voice, Recorded CSM 1.6-kbps TM and Scientific Data (d)	32:1 Playback of (CSM - Recorded) LM 1.6-kbps TM	TV	Real-Time Scientific (d)	Real- 51.2-
FM DOWNLINK MODULATION PROCESS	Modulation Schemes; Subcarrier Characteristics	TV : FM Directly on carrier (2272.5 MHz) Playback Voice: FM Directly on carrier (2272.5 MHz) Scientific Data (d) : FM/FM (3 subcarriers) 95 kHz 125 kHz 165 kHz Playback LM TM : PCM/FM Playback CSM TM (e) : PCM/PSK/FM; 1.024 MHz subcarrier bi-phase modulated ±90°					
	Peak Carrier Deviation (Δf)	Playback Voice : 100 kHz +20 percent -40 percent Playback CSM TM (e): 600 kHz ±15 percent Playback LM TM : 200 kHz +25 percent -50 percent TV : 1 MHz ±10 percent Scientific Data (d) (Real-Time): FM/FM 75 kHz ±15 percent (95 kHz SC) 108 kHz ±15 percent (125 kHz SC) 168 kHz ±15 percent (165 kHz SC)					

(a) Or voice and biomed.

(b) In the event of an EVA, the EVA biomed data is relayed via the CSM S-Band link on the voice subca otherwise the biomed data comes back as PCM telemetry.

(c) Varies with the received uplink.

(d) Scientific data not used

(e) Auxiliary PMP mode will provide real time PCM with same USB-FM characteristics as playback PCM.

NK MODES AND MODULATION PROCESS

PM MODES

8	9	10	11	12	13	14	15	16	0
rier	Carrier	Carrier	Carrier	Carrier	Carrier	Carrier	Carrier	Carrier	
kup ice	--	Backup Voice	Voice	Voice	--	Backup Voice	--	Backup Voice	No Carrier
-kbps M	1.6-kbps TM	--	--	--	51.2-kbps TM	--	51.2-kbps TM	51.2-kbps TM	
--	PRN	--	PRN	--	--	--	PRN	--	
--	--	--	--	--	--	--	--	--	

for voice and biomed) ⓑ

FM MODES

	7	8	9	10	11	12	0
TM	Real-Time 1.6-kbps TM ⓔ	1:1/32:1 Playback of Scientific Data and Real Time 51.2-kbps TM	1:1/32:1 Playback of Scientific Data and Real Time 1.6-kbps TM	8:1 Playback of (CSM-Recorded) LM 1.6-kbps TM	Same as Mode 1 Except No Scientific Data	Same as Mode 2 Except No Scientific Data	No Carrier

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TABLE 6-IV.- S-BAND UPLINK MODES AND MODULATION PROCESS

	MODE NUMBER	1	2	3	4	5	6	7	8	9	0
PM UPLINK MODES AVAILABLE	Channels Included	Carrier PRN -- --	Carrier -- Voice --	Carrier -- -- Updata	Carrier PRN Voice --	Carrier PRN -- Updata	Carrier PRN Voice Updata	Carrier -- Voice Updata	Carrier PRN Backup Voice --	Carrier -- -- --	-- -- -- --
PM UPLINK MODULATION PROCESS	Modulation Schemes; Subcarrier Characteristics	PRN : PM directly on carrier Voice : FM/PM; 30-kHz subcarrier deviated ±7.5 kHz (peak) Updata : PSK/FM/PM; 70-kHz subcarrier deviated ±5.0 kHz (peak) Backup Voice: FM/PM; 70-kHz subcarrier deviated ±5.0 kHz (peak)									

	MODE NUMBER	1	2	3	4	5	6	7	8	9	0
Carrier Phase Deviation (Radians-Peak)*	PRN	1.34	--	--	0.38	0.38	0.44	--	0.38	NA	NA
	Voice	--	1.85	--	1.20	--	1.00	1.10	--		
	Updata	--	--	1.85	--	1.20	1.00	1.10	--		
	Backup Voice	--	--	--	--	--	--	--	1.20		

*All phase deviations have ±10% tolerance.

TABLE 6-V.- PREMODULATION PROCESSOR

ITEM	FUNCTION and/or PARAMETERS
1. Weight	14.5 pounds
2. Cooling	ECS Primary and/or Secondary Glycol Loops.
3. Electrical Power	
a. Input Voltage	28 ± 4 Vdc
b. Input Power	8.5 Watts
4. CM Down Voice Channel (Normal)	
a. Subcarrier	1.25 MHz derived from CTE 512 kHz.
b. Response	300 to 3000 Hz flat within 6 db.
5. CM Down Voice Channel (Backup)	
a. Response	300 to 2300 Hz flat within 6 db.
6. LM/EVA Voice and LM Biomed Relay Channel	
a. Subcarrier	1.25 MHz derived from CTE 512 kHz.
b. Subcarrier Deviation	LM Voice - 8 kHz EVA Voice and Biomed - 9 kHz
c. Response	300 to 13,000 Hz flat within 2 db.
d. LM Input	Voice
e. EVA Input	Voice and/or 7 Biomed Subcarriers 4.0 kHz ± 5% f_o 5.4 kHz ± 5% f_o 6.8 kHz ± 5% f_o 8.2 kHz ± 5% f_o 9.6 kHz ± 4% f_o 11.0 kHz ± 3% f_o 12.4 kHz ± 3% f_o
7. Tape Recorder Output - LM & CSM Voice	LM and CSM intercom voice are mixed and output to DSE for recording.
a. Response	300 to 2300 Hz flat within 2 db.

*

TABLE 6-V.- PREMODULATION PROCESSOR - Continued

ITEM	FUNCTION and/or PARAMETERS
8. LM PCM Output Channel	LM PCM (1.6 kbs) is limited and output to DSE for recording.
a. Response	600 to 2800 Hz flat within 1 db.
9. CM PCM Data Channel (Real-Time and Playback)	
a. Input	51.2 kbs or 1.6 kbs NRZ PCM data.
b. Subcarrier	1.024 MHz derived from PCM 512 kHz ref signal.
c. Modulation	Bi-phase
10. Scientific Data Channel (Real-Time)	
a. Response	Flat within 2 db Channel 1 0 to 2850 Hz 2 0 to 3750 Hz 3 0 to 4950 Hz
b. Frequency and Deviation	Channel 1 95 kHz +7.5% f_o 2 125 kHz +7.5% f_o 3 165 kHz +7.5% f_o
11. Scientific Data Channel (Playback)	
a. Response	Flat within 2 db Channel 32:1 Playback 1:1 Playback 1 12.5 to 89 Hz 50 to 2850 Hz 2 12.5 to 117 Hz 50 to 3750 Hz 3 12.5 to 154 Hz 50 to 4950 Hz (Recorded data bandwidths)
12. Tape Recorder Input - LM PCM Channel	
a. Response	15 to 90 kHz flat within 1 db.
13. Uplink Subcarrier Detectors	
a. Up Voice	30 kHz (Normal) 70 kHz (Backup)
b. Updata	70 kHz
c. Response	300 to 4,000 kHz flat within 3 db.

TABLE 6-V.- PREMODULATION PROCESSOR - Concluded

ITEM	FUNCTION and/or PARAMETERS
14. Emergency Key Control	512 kHz signal derived from CTE 512 kHz timing signal baseband modulates S-Band PM carrier when key is depressed. A 400 Hz sidetone output to the audio center is provided when key is depressed.
15. Data Rate Indicator Control	DC signal from PCM to control modulation levels to PM & FM modulator modules. HBR = 5.3 Vdc LBR = 0 Vdc
16. Television Channel	
a. Direct Output	To S-Band FM transmitter
b. Response	DC to 500 kHz flat within 0.5 db.
c. Isolated Output	To GSE hardline
d. Response	10 to 500,000 Hz flat within 3 db.

TABLE 6-V.- PREMODULATION PROCESSOR - Concluded

ITEM	FUNCTION and/or PARAMETERS
14. Emergency Key Control	512 kHz signal derived from CTE 512 kHz timing signal baseband modulates S-Band PM carrier when key is depressed. A 400 Hz sidetone output to the audio center is provided when key is depressed.
15. Data Rate Indicator Control	DC signal from PCM to control modulation levels to PM & FM modulator modules. HBR = 5.3 Vdc LBR = 0 Vdc
16. Television Channel	
a. Direct Output	To S-Band FM transmitter
b. Response	DC to 500 kHz flat within 0.5 db.
c. Isolated Output	To GSE hardline
d. Response	10 to 500,000 Hz flat within 3 db.

TABLE 6-V.- PREMODULATION PROCESSOR - Concluded

ITEM	FUNCTION and/or PARAMETERS
14. Emergency Key Control	512 kHz signal derived from CTE 512 kHz timing signal baseband modulates S-Band PM carrier when key is depressed. A 400 Hz sidetone output to the audio center is provided when key is depressed.
15. Data Rate Indicator Control	DC signal from PCM to control modulation levels to PM & FM modulator modules. HBR = 5.3 Vdc LBR = 0 Vdc
16. Television Channel	
a. Direct Output	To S-Band FM transmitter
b. Response	DC to 500 kHz flat within 0.5 db.
c. Isolated Output	To GSE hardline
d. Response	10 to 500,000 Hz flat within 3 db.

TABLE 6-VI.- VHF AM TRANSCEIVER EQUIPMENT

ITEM	FUNCTION and/or PARAMETERS	
1. Weight	13 pounds Maximum	
2. Cooling	ECS Primary and/or Secondary Glycol Loop	
3. Electrical Power		
a. Input Voltage	28 ± 4 Vdc	
b. Input Power	Duplex A (Key OFF)	4.2 Watts
	Duplex A (Key ON)	28.8 Watts
	Simplex A (Key OFF)	4.1 Watts
	Simplex A (Key ON)	28.8 Watts
	Duplex B (Key OFF)	3.8 Watts
	Duplex B (Key ON)	27.6 Watts
	Simplex B (Key OFF)	4.0 Watts
	Simplex B (Key ON)	27.6 Watts
	RCV A Only	1.2 Watts
	RCV B Only	1.2 Watts
	PTT (Key ON)	1.3 Watts
4. Transmitter (A or B)		
a. Activation Time	250 milliseconds maximum to reach standby condition.	
	20 milliseconds maximum to reach full transmit power from PTT (Key ON)	
b. RF Output	5 DBW (average) minimum	
c. XMTR Frequency	XMTR A 296.8 MHz ± 8.90 kHz XMTR B 259.7 MHz ± 7.79 kHz	
d. Modulation	Modulated by clipped speech between 300 and 2000 Hz combined with a 30 kHz signal such that the ON-OFF duty cycle of the RF carrier (50 ± 5 percent) is speech signal dependent and the ON-OFF period is 30 kHz. When XMTR is keyed ON with no speech input the average RF Output is 5 DBW minimum.	
5. Receiver (A or B)		
a. Activation Time	500 milliseconds maximum to reach full receive operation from turn-on.	
	100 milliseconds maximum to reach full receive operation from PTT release (Key OFF).	

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TABLE 6-VI.- VHF AM TRANSCEIVER EQUIPMENT - Concluded

ITEM	FUNCTION and/or PARAMETERS
b. RCVR RF Input	2 to 625,000 Microvolts
c. A&B Output Response	
(1) Output to Audio Center (Voice)	300 to 3000 Hz, + 2db - 3 db maximum variation, down 12 db minimum at 5000 Hz.
(2) Output to PMP (Voice and Biomed Data)	300 to 13,000 (2 db).
d. RCVR B LM PCM Output	300 to 13,000 Hz (2 db).
e. RCVR Squelch	Adjustable by MDC2 controls for between 0 and 10 to 25 microvolts. 9 on squelch control is maximum squelch (10 to 25 microvolt level)

TABLE 6-VI.- VHF AM TRANSCEIVER EQUIPMENT - Concluded

ITEM	FUNCTION and/or PARAMETERS
b. RCVR RF Input	2 to 625,000 Microvolts
c. A&B Output Response	
(1) Output to Audio Center (Voice)	300 to 3000 Hz, + 2db - 3 db maximum variation, down 12 db minimum at 5000 Hz.
(2) Output to PMP (Voice and Biomed Data)	300 to 13,000 (2 db).
d. RCVR B LM PCM Output	300 to 13,000 Hz (2 db).
e. RCVR Squelch	Adjustable by MDC2 controls for between 0 and 10 to 25 microvolts. 9 on squelch control is maximum squelch (10 to 25 microvolt level)

TABLE 6-VII.- AUDIO CENTER EQUIPMENT

ITEM	FUNCTION and/or PARAMETERS
1. Weight	7.9 pounds
2. Cooling	ECS Primary and/or Secondary Glycol Loop
3. Electrical Power	
a. Input Voltage	28 ± 4 Vdc
b. Input Power	14.2 Watts (3 Stations ON)
4. Stations	Left Couch Station Right Couch Station Center Couch Station
5. Microphone Amplifier (1 Each Station)	
a. Input	0 dbm sound pressure level (nominal)
b. Response	300 to 3000 Hz flat within 2 db
c. Automatic Volume Control	
(1) Range	Less Than 4 db change for 20 db input change
(2) Attack Time	50 milliseconds
(3) Release Time	1 to 6 seconds
(4) Threshold	13 ± 3 db (referred to input)
d. Output	0 dbm ± 3 db at threshold
e. Isolation	30 db or greater between modulation output channels
6. Earphone Amplifier (1 Each Station)	
a. Input	Variable over 35 db range of given input signal
b. Output	With 13 db on input attenuator the output is 20 dbm ± 3 dbm
c. Response	300 to 3000 Hz flat within 2 db
d. Isolation	40 db or greater between input channels
7. Voice Operated Relay (VOX)	
a. VOX Sensitivity	Adjustable for input from -10 dbm to +10 dbm
b. VOX Attack	Less than 50 milliseconds
c. VOX Release	2 ± 0.7 seconds

TABLE 6-VII.- AUDIO CENTER EQUIPMENT - Concluded

ITEM	FUNCTION and/or PARAMETERS
8. Intercom Bus	
a. GSE Output	(Not Used)
b. Swimmer Output	For recovery voice to recovery swimmers
c. Tape Recorder	Output for voice recording on DSE
9. Spacecraft/GSE Facility Hardline Voice Interface	The Pad COMM Switch and Volume Control are used to operate each audio stations input/output voice links with the checkout and launch facilities.

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TABLE 6-VIII.- UPDATA LINK EQUIPMENT

ITEM	FUNCTION and/or PARAMETERS
1. Weight	21 pounds maximum
2. Cooling	ECS Primary and/or Secondary Glycol Loops
3. Electrical Power	
a. Input Voltage	28 + 2, -4 Vdc
b. Input Power	8.9 Watts maximum
4. Information Signal	
a. Modulation	Phase shift key FM modulation of 70 kHz S-Band uplink subcarrier. Modulation deviation is ± 5 kHz.
b. Sub-bit "ONE"	Sub-bit "one" begins when the positive transition of the 1 kHz information signal cross each other in-phase.
c. Sub-bit "Zero"	Sub-bit "zero" begins when the positive transition of the 1 kHz sync signal crosses the 2 kHz information signal 180 degrees out-of-phase.
d. Sub-bit Period	One millisecond.
e. Sub-bit Rate	1,000 bits per second.
5. Message Structure	
a. Sub-bit Code	5 sub-bits per information bit. Vehicle address sub-bit code is different than system address and data word. Sub-bit coding (See Drawing 6.5)
b. Message Code	Each message contains up to 30 information bits which consists of a vehicle address, system address, and data word. (See Drawing 6.5)
(1) Vehicle Address	Eight possible codes selectable by hard wire on an external connector.
(2) System Address	1. Command Module Computer 2. Real-Time Command (Internal relays) 3. Real-Time Command (External relays) (not used) 4. Central Timing Equipment 5. Salvo RTC reset 6. Test message A & B 7. Auxiliary decoder (not used)
(3) Data Word	(See Drawing 6.5)

TABLE 6-VIII.- UPDATA LINK EQUIPMENT - Continued

ITEM	FUNCTION and/or PARAMETERS
6. Sub-bit Detector	The 1 kHz and 2 kHz PSK signals are separated to provide synchronization and sub-bit data.
a. Sub-bit Sync	Recovered by phase lock techniques. Three five sub-bit sequences must precede a command message to synchronize the UDL.
b. Sub-bit Data	Detected at a 1 kHz rate.
7. Decoder Operation	The vehicle address decoded as "access" bits are decoded asynchronously (without sync). Message timing in the decoder is not established until after vehicle address is decoded. Vehicle address recognition disables access bit decoding and enables the decoding of the remaining message. The system address determines information for receiving the correct number of info bits and processing a particular data word. After the proper number of bits have been received and temporarily stored in the main register, the program control modifies the operation to enable processing or transfer of the data word.
8. Verification Signal	When a complete message is received, processed or transferred without the detection of sub-bit or bit errors and without the occurrence of a logic power deviation the parallel 4-bit verification code to the PCM TM will be as follows: PCM BIT — B1 B2 B3 B4 UDL OFF — 0 0 0 0 *TEST A — 0 1 1 0 *TEST B — 1 0 0 1 *SYS VAL — 0 1 0 1 UDL STANDBY (ON) — 1 0 1 0 *Verification signal is presented to the PCM as follows: PCM HBR 55 milliseconds PCM LBR 250 milliseconds

TABLE 6-VII.- UPDATA LINK EQUIPMENT - Concluded

ITEM	FUNCTION and/or PARAMETERS
9. Internal Relays	
a. Type	32 double-pole double-throw relays, magnetic latching
b. Rating	2 ampere, minimum, contact rating
c. Actuation Time	Opening or closure less than 10 milliseconds.

TABLE 6-IX.- TELEVISION CAMERA, SLOW SCAN

ITEM	FUNCTION and/or PARAMETERS
1. Weight	6.8 pounds maximum
2. Cooling	Not required
3. Electrical Power	
a. Input Voltage	24 to 31 Vdc
b. Input Power	6.75 Watts
4. Activation Time	TBD
5. Resolution	250 EIA Test Pattern Lines (Electronic Industries Association)
6. Scanning Rates	
a. Lines	320 Lines-per-Frame
b. Frames	10 Frames-per-Second
7. Video Bandwidth	40 to 400,000 Hz (3 db) 400 kHz to 500 kHz (+3, -12 db) 20 db Roll - Off
8. Gray Scales	5 minimum (Black to white is positive signal)
9. Illumination levels	0.1 to 30 foot candles
10. Automatic Light Control Switch	
a. "ALC" Position	Camera will operate in specification over light levels in Item 8.
b. "OFF" Position	Camera will operate in specification over light levels of 6.3 to 22 foot candles. (20 Watt flourescent lamp ≈ 4870 foot candles)
11. Optics	
a. Fixed Focal Length Lens	80 degrees field of view and 25 to 90 inches depth of view at lens aperature of f2.
b. Variable Focal Length Lens and View Finder	Adjustable from 20 to 80 millimeters with f2.5 minimum aperature.

TABLE 6-X.- RENDEZVOUS RADAR TRANSPONDER

ITEM	FUNCTION and/or PARAMETERS
1. Weight	13.63 pounds
2. Cooling	ECS SM Primary and/or Secondary Glycol Loops.
3. Electrical Power	
a. DC Voltage	25 to 31.5 Vdc
b. Power	70.5 Watts (Transponder) 14 Watts (Heater)
4. Activation Time	TBD
5. Receiver	
a. Type	Solid state coherent radar transponder
b. Frequency	9832.8 MHz ± 30 kHz Offset by doppler ± 49 kHz with maximum
c. Modulation	3 sinusoidal tones (PM on carrier) 204.8 kHz ± 0.0015%, 20 ± 2 degrees 6.4 kHz ± 0.0015%, 20 ± 2 degrees 0.2 kHz ± 0.0015%, 24 ± 2 degrees
d. Dynamic Range	-123 dbm to -18 dbm at antenna terminals.
e. Acquisition	Acquires rendezvous radar in 1.3 seconds at -123 dbm or greater.
6. Transmitter	
a. Type	Solid state coherent radar transponder
b. Frequency	
(1) Search	9792 MHz ± 25 kHz and swept ±104 kHz minimum.
(2) Transpond	240/241 times receive frequency.
c. RF Output Power	Greater than 240 milliwatts
d. Modulation	Received tones transponded with modulation index same as received except ±4 degree tolerance.
7. Mode Operation	
a. Transponder	In operation at all times a signal is being received.
b. Signal Search	In operation when no signal is being received. Transmit frequency is swept ±104 kHz with a saw-tooth function at 200 kHz rate.

TABLE 6-X.- RENDEZVOUS RADAR TRANSPONDER - Concluded

ITEM	FUNCTION and/or PARAMETERS
c. Self Test	In operation when selected by systems test switch S1, LEB 101. Test checks receiver operation by inserting 40.8 MHz signal between mixer stage and preamp input to first IF.
8. Display Outputs	
a. AGC Monitor	0 to 5 Vdc
b. Frequency Lockup	0 ± 0.4 Vdc (Search Mode) 4.5 ± 0.45 Vdc (Transponder Mode)
c. RF Power	2.5 ± 0.4 Vdc
9. Range	Between 50 feet and 400 n.mi.
a. Range Accuracy	200 Hz tone ± 12,044.74 feet 64 kHz tone ± 425.22 feet 204.8 kHz tone ± 57.63 feet
b. Range Rate Accuracy	0.25 percent or 1 foot per second (which ever is greater) based on LM Guidance Computer sampling period of 100 milliseconds.

TABLE 6-XI.- VHF RECOVERY BEACON

ITEM	FUNCTION and/or PARAMETERS
1. Weight	2.7 pounds maximum
2. Cooling	Not required
3. Electrical power	
a. Input Voltage	28 ± 4 Vdc
b. Input Power	6.9 Watts maximum average over interruption cycle
4. RF Output Power	3 Watts minimum during the ON time of the interruption cycle
5. XMT Frequency	243 ± 0.0126S MHz
6. Modulation	Carrier is amplitude - modulated by 1 kHz square wave, 20 to 40 percent.
7. Interruption Cycle	Modulated carrier is present at the output for 2 seconds and absent for 3 seconds.

TABLE 6-XII.- VHF SURVIVAL BEACON - TRANSCEIVER

ITEM	FUNCTION and/or PARAMETERS
1. Weight	5 pounds maximum including battery pack.
2. Cooling	Not required
3. Electrical	
a. DC Voltage	-30 Vdc and -20 Vdc from attachable battery pack.
b. Power	Battery pack life is 24 hours in 100% beacon operation with 40% duty cycle.
4. Activation Time	No appreciable warm-up period
5. Receiver	
a. Type	Portable, VHF AM Beacon - transceiver with integral microphone, speaker, PTT pushbutton battery and antenna.
b. Frequency	243 MHz
c. Dynamic Range (Sensitivity)	7.5 microvolts at $\frac{S + N}{N} \geq 10$ db when 30% modulated by 1 kHz.
d. Selectivity	6 db at $f_c \pm 1.5$ MHz, 60 db at $f_c \pm 9$ MHz
e. Audio Output	103 db SPL with 1000 microvolt input
6. Transmitter	
a. Frequency	243 MHz
b. RF Output	(Short circuit protection)
(1) Beacon	2 Watts (0 hrs), 0.9 Watts (24 hrs)
(2) Voice	1.4 Watts minimum (90% modulation)
c. Modulation	
(1) Beacon	1 kHz tone on carrier. Carrier duty cycle is 2 ± 0.2 seconds on and 3 ± 0.3 seconds off.
(2) Voice	0 - 90% from 300 to 3000 MHz

TABLE 6-XIII.- ANTENNA SWITCH, S-BAND

ITEM	FUNCTION and/or PARAMETERS
1. Weight	2.5 pounds
2. Cooling	Not required
3. Electrical Power	
a. Input Voltage	23 to 30 Vdc
b. Input Power	12 Watts (For Omni Position)
4. Actuation Time	150 milliseconds maximum
5. Mechanics	Non-latching, 5-position, break-before-make.
6. Isolation	40 db minimum between RF lines

TABLE 6-XIV.- ANTENNA SWITCH, VHF

ITEM	FUNCTION and/or PARAMETERS
1. Weight	0.75 pounds maximum
2. Cooling	Not required
3. Electrical Power	
a. Input Voltage	None - Manual Switch
b. Input Power	None - Manual Switch
4. Actuation Time	Not applicable
5. Mechanics	Manual, 3-position, make-before-break
6. Isolation	40 db minimum between RF lines

TABLE 6-XV.- ANTENNA, S-BAND OMNI

ITEM	FUNCTION and/or PARAMETERS
1. Type	Helix in loaded cavity
2. Frequency	2100 MHz to 2300 MHz
3. Gain	Greater than -3 db relative to isotropic source between $\theta \geq 45°$ and $\theta \geq 145°$ (See Coverage)
4. Polarization	Right-hand circular
5. Coverage	The following coverage is applicable with sequential selection of the four antennas: *GAIN SOLID ANGLE $\geq$ -3 db between θ = 45° and 145° $\geq$ -20 db between θ = 15° and 165° $\geq$ -24 db between θ = 10° and 170° GAIN WILL BE LESS THAN -24 db for cones, with solid angles of 20 degrees at the spacecraft nose and SPS nozzel. *Applicable for ϕ = 0° to 360°
6. Power Rating	15 Watts of CW RF

TABLE 6-XVI.- ANTENNA, VHF SCIMITAR

ITEM	FUNCTION and/or PARAMETERS
1. Type	Scimitar blade - one inch thick cover for thermal protection.
2. Frequency	225 MHz to 450 MHz
3. Gain	Greater than -3 db (On axis) Relative to isotropic source.
4. Polarization	Slant Linear
5. Coverage	Each antenna covers a hemisphere, approximately full coverage obtainable with antenna selection.
6. Power Rating	50 Watts average

TABLE 6-XVII.- ANTENNA, VHF RECOVERY

ITEM	FUNCTION and/or PARAMETERS
1. Type	10 inch erectible tape with ground plane wiskers
2. Frequency	243 MHz tuned
3. Gain	+6 db with respect to isotropic source, -18 db null
4. Polarization	Vertical
5. Coverage	±70 degree elevation 360 degrees azimuth
6. Power Rating	50 Watts continuous

TABLE 6-XVIII.- ANTENNA, RENDEZVOUS RADAR TRANSPONDER

ITEM	FUNCTION and/or PARAMETERS
1. Type	Open ended waveguide
2. Frequency	9782 MHz to 9802 MHz (XMT) 9822 MHz to 9842 MHz (RCV)
3. Gain	Greater than 0 db above isotropic source
4. Polarization	Linear
5. Coverage	Gain is maintained over solid angle of 160 degrees (X-axis) by 105 degrees (axis at right angle to X-axis)

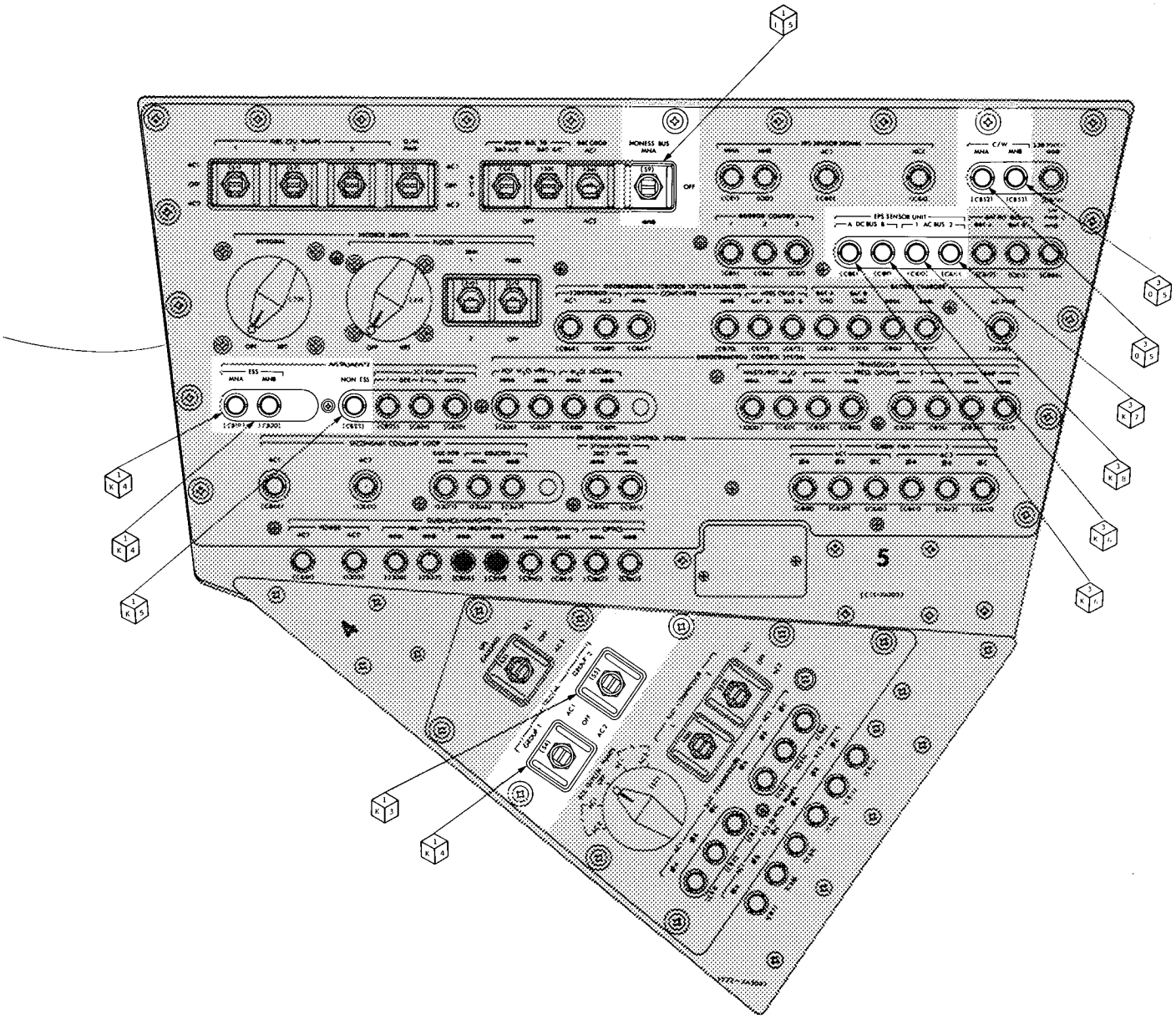
* TABLE 6-XIX.- ANTENNA, HIGH-GAIN

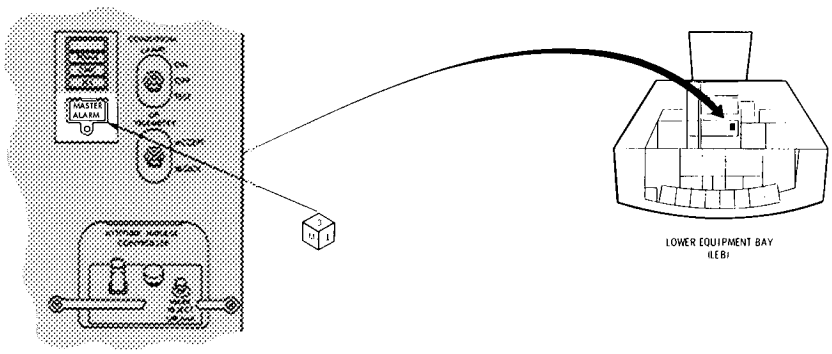
CSM 104

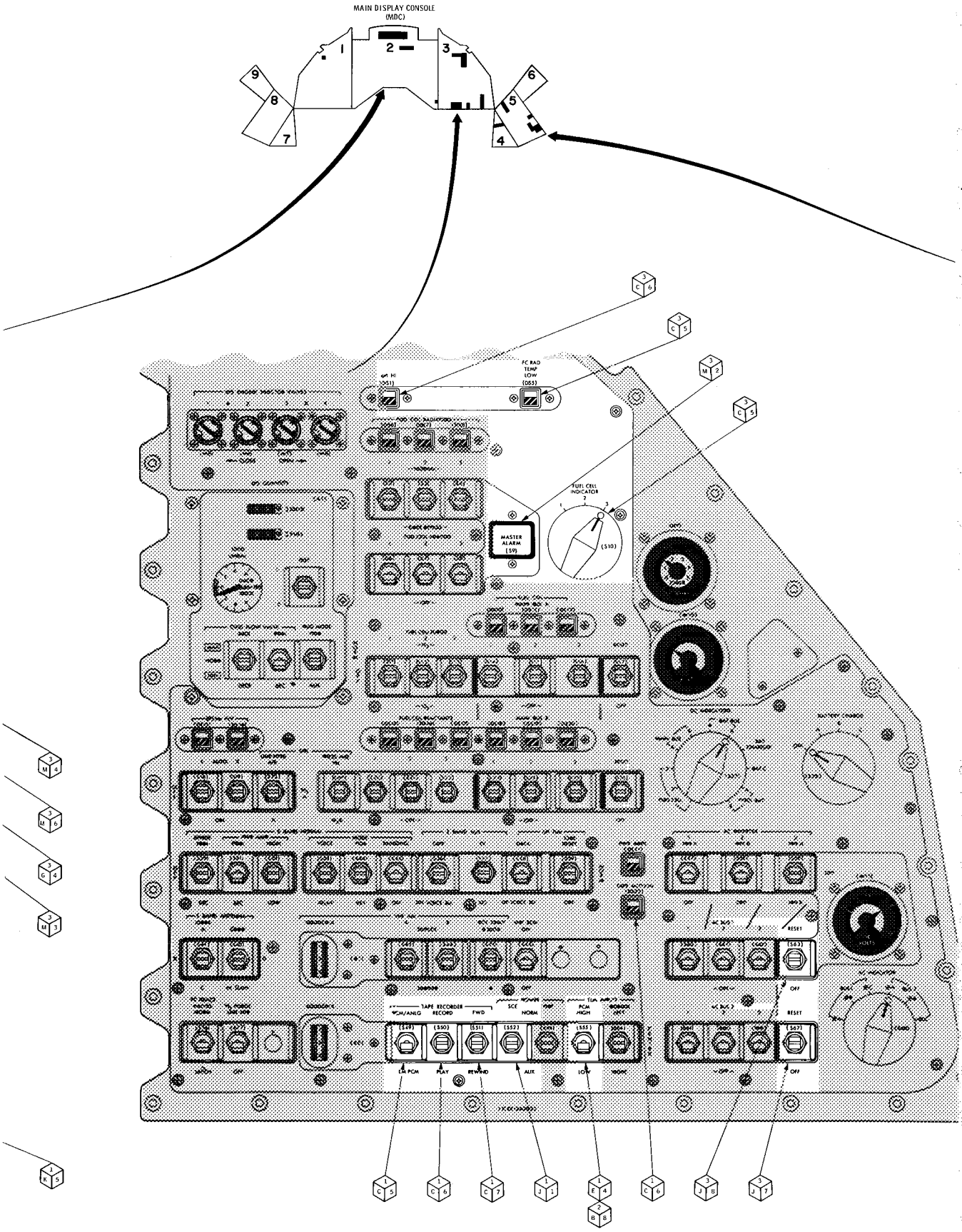
ITEM	FUNCTION and/or PARAMETERS
1. Type	Multi-mode, variable gain, beamwidth, steerable antenna, consisting of four parabolas, a central horn, three-axis gimbal system and control logic.
2. Frequency	Transmit: 2272.5 ± 2.5 MHz 2287.5 ± 2.5 MHz Receive: 2106.4 ± 2 MHz
3. Gain (On Axis) and Beamwidth (3 db) for XDV-5 Antenna and Electronics Box	XMT MODE / GAIN / BEAMWIDTH Wide 8.0 db 40.0° Medium 19.6 db 7.9° ΔNarrow 25.9 db 3.9° RCV MODE / GAIN / BEAMWIDTH Wide 3.8 db 40.0° *Narrow 22.8 db 3.9° ΔNarrow 23.3 db 3.9°
4. Polarization	Right-Hand Circular
5. Coverage	Spherical except for pointing angles where the MSFN to the high gain antenna (HGA) line of site is shadowed by the CSM. Shadow area covers approximately 40 percent of sphere.
6. RF Power Rating	15 Watts Continuous
7. Electrical Power	
a. DC Voltage	28 + 2, - 4 Vdc
b. AC Voltage	115/200 Vac, 400 Hz, 3-Phase
c. DC Power (Watts)	16.45 (PRIM), 22.84 (SEC)
d. AC Power (Watts RMS)	34.5(PRIM), 34.5 (SEC)
8. Weight	94 Pounds maximum
9. Acquisition Range	60 degrees or less from boresight axis when line of sight is outside RF Scan Limits.
10. Track Mode Transfer	Wide track to narrow track switching occurs for tracking errors less than 1 degree. HGA will switch back to wide track if the tracking errors increase to greater than 3 degrees.
11. RF Scan Limit	Electronic limit set to correspond to CSM RF shadow profile.

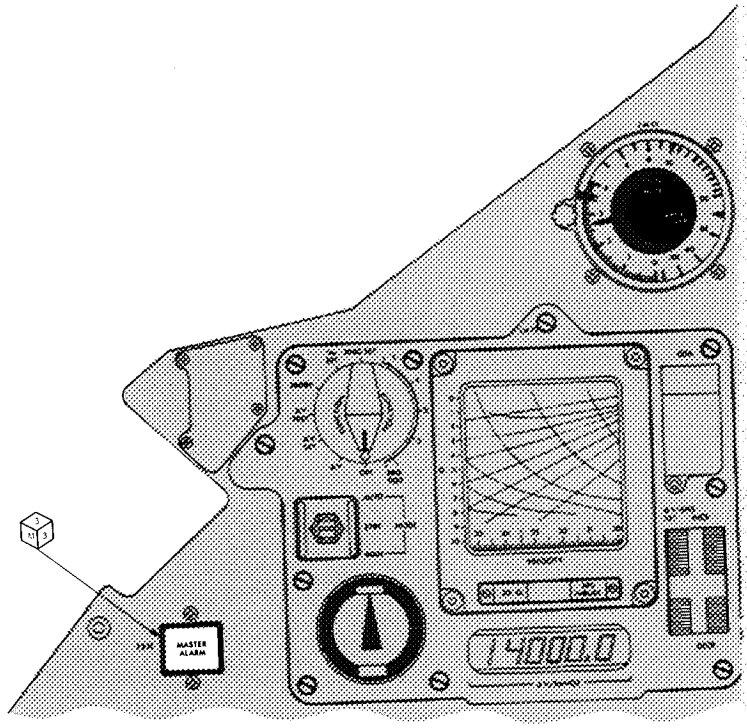
ITEM	FUNCTION and/or PARAMETERS
12. Gimbal Limits	
A-axis	360° Rotation
B-axis	±23.5°
C-axis	+125°, -4
	A-, B-, and C-axis are at 0 degrees when B-axis is parallel to CSM X-axis and C-axis forms a right angle with A-axis. When onboard pitch and yaw indicators read 0 degrees. A-axis equals 0 degrees, B-axis equals 0 degrees, and C-axis equals + 90 degrees.
13. Scan Warning Light	Warning limit is set 15 ± 3 degrees outside RF Scan Limit.
14. Deployment	Deployment is initiated by SLA Panel Deployment. The HGA boom is pivoted in the deployment mechanism by spring-loaded push arms. Deployment period is nominally 10 seconds.

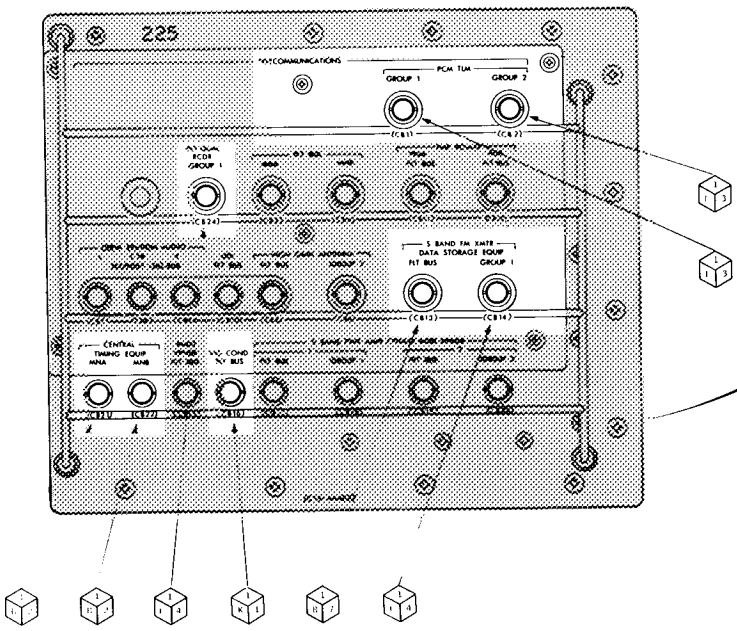
7 INSTRU-
MENTATION

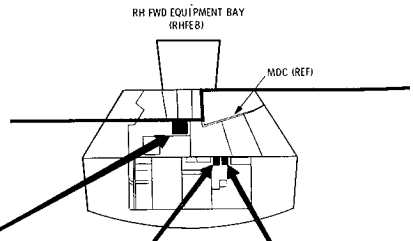

MONNESS BUS
MNA
OFF
C/W
MNA
MNB
ESS
MNA
MNB
NON ESS
5

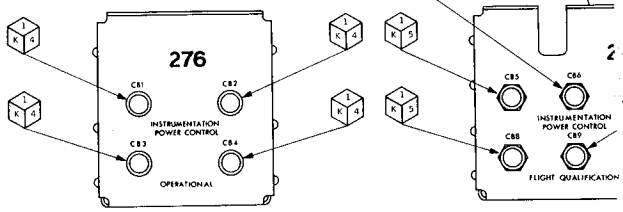

MASTER ALARM
LOWER EQUIPMENT BAY
(LEB)


MAIN DISPLAY CONSOLE
(MDC)
1
2
3
4
5
6
7
8
9
MASTER ALARM
(S9)
(S10)
RESET
OFF
TAPE RECORDER
RECORD
FWD
REWIND
PLAY
AUX
LOW
HIGH
NORM
(S49)
(S50)
(S51)
(S52)
(S55)
(S67)

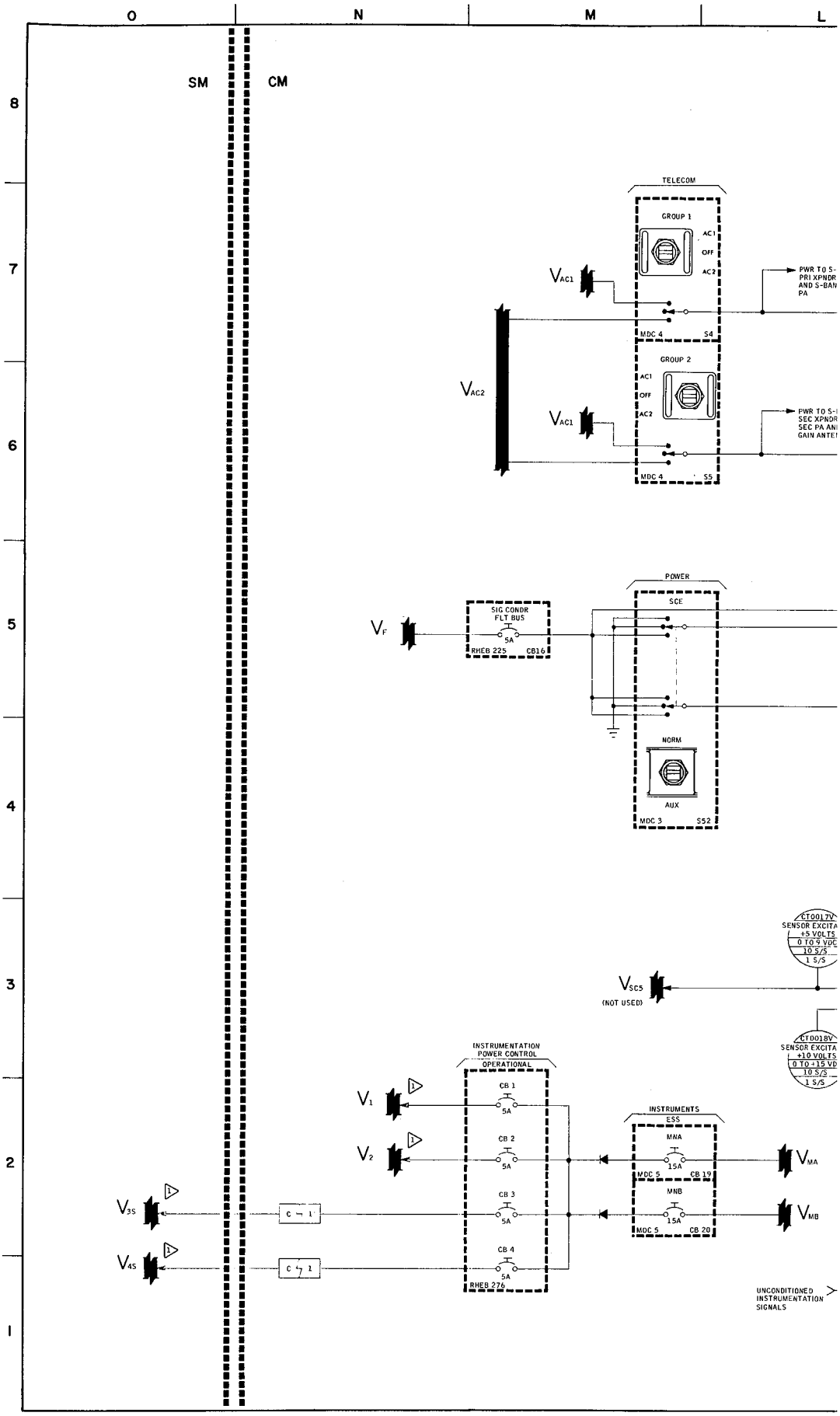


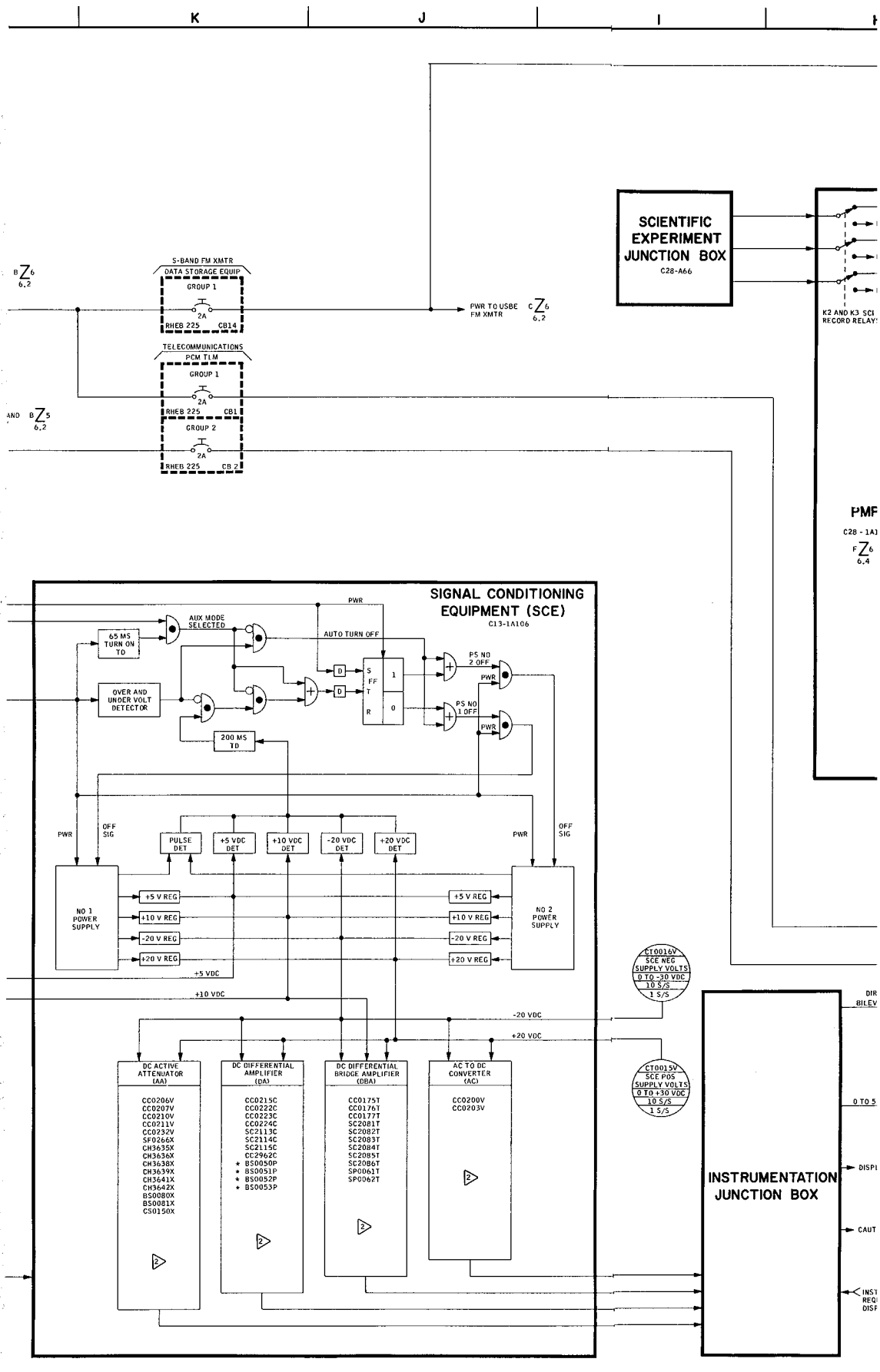


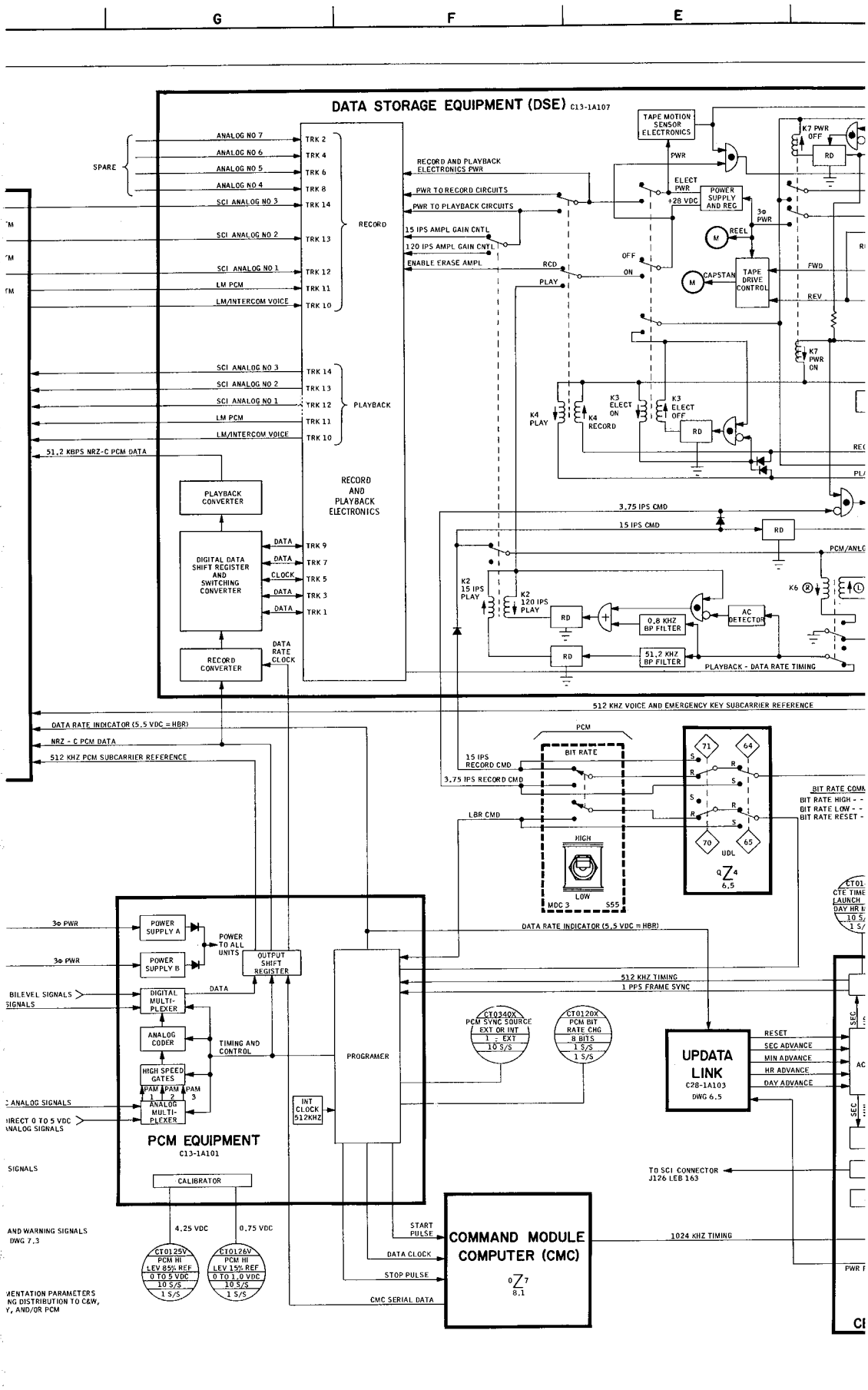


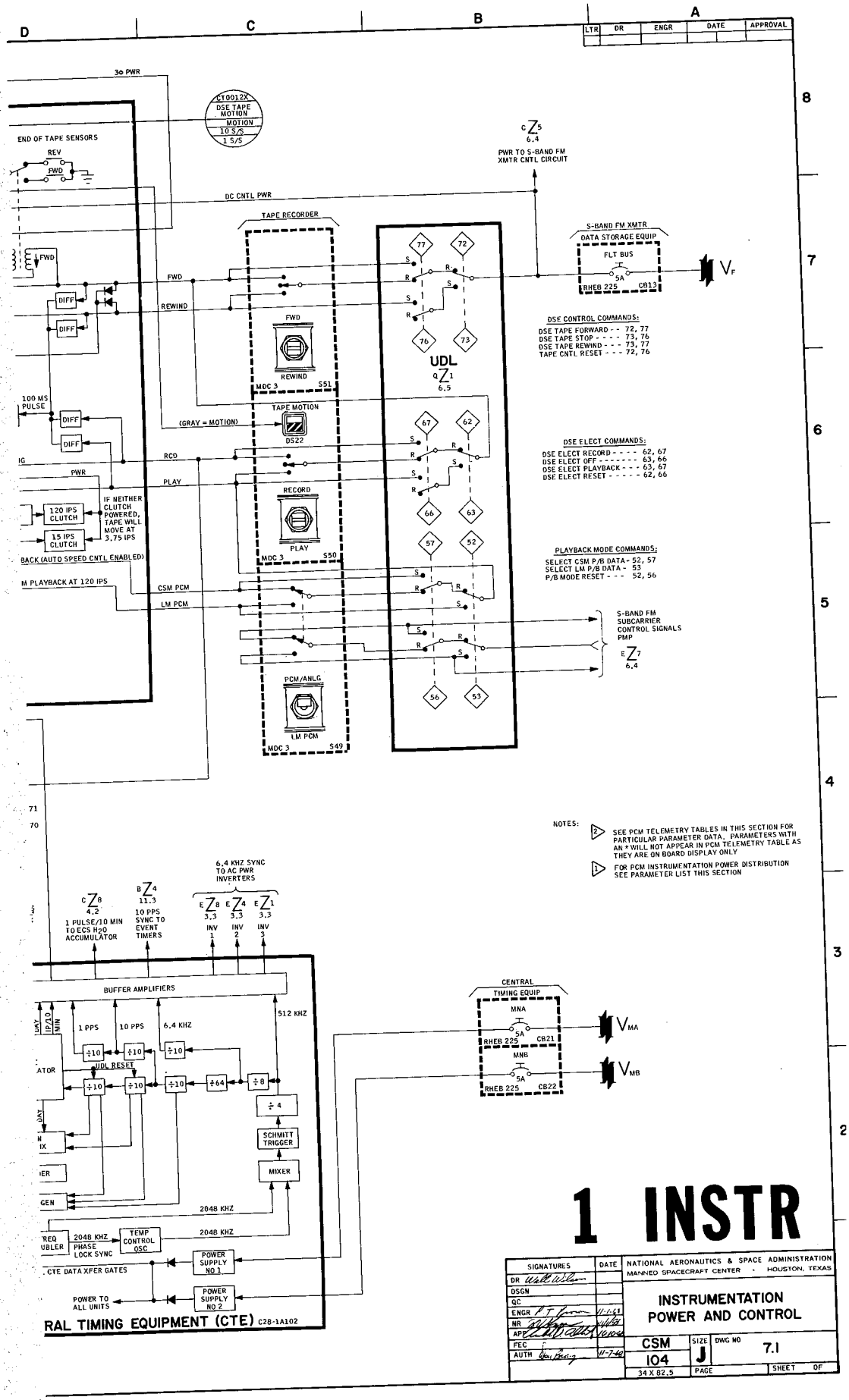


NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER · HOUSTON, TEXAS		
INSTRUMENTATION CONTROL-DISPLAY FIGURE		
DWG NO. FIGURE 7.1	SIZE J	CSM 104
SHEET OF PAGE		36 X 111


O
N
M
L
SM
CM
8
7
6
5
4
3
2
1
TELECOM
GROUP 1
AC1
OFF
AC2
V_{AC1}
PWR TO S-
PRI XPNDR
AND S-BAN
PA
MDC 4
S4
GROUP 2
AC1
OFF
AC2
V_{AC2}
V_{AC1}
PWR TO S-
SEC XPNDR
SEC PA AN
GAIN ANTE
MDC 4
S5
POWER
SCE
V_F
SIG CONDR
FLT BUS
5A
RHEB 225
CB16
NORM
AUX
MDC 3
S52
CT0017V
SENSOR EXCITA
+5 VOLTS
0 TO 9 VDC
10 S/S
1 S/S
V_{SC5}
(NOT USED)
CT0018V
SENSOR EXCITA
+10 VOLTS
0 TO +15 VD
10 S/S
1 S/S
INSTRUMENTATION
POWER CONTROL
OPERATIONAL
CB 1
5A
V_1
CB 2
5A
V_2
CB 3
5A
V_{3S}
CB 4
5A
V_{4S}
RHEB 276
INSTRUMENTS
ESS
MNA
15A
MDC 5
CB 19
V_{MA}
MNB
15A
MDC 5
CB 20
V_{MB}
UNCONDITIONED
INSTRUMENTATION
SIGNALS


K
J
I
SCIENTIFIC EXPERIMENT JUNCTION BOX
C28-A66
K2 AND K3 SCI RECORD RELAY
S-BAND FM XMTR
DATA STORAGE EQUIP
GROUP 1
2A
RHEB 225 CB14
PWR TO USBE FM XMTR
TELECOMMUNICATIONS
PCM TLM
GROUP 1
2A
RHEB 225 CB1
GROUP 2
2A
RHEB 225 CB 2
PMF
C28 - 1A1
SIGNAL CONDITIONING EQUIPMENT (SCE)
C13-1A106
PWR
AUX MODE SELECTED
AUTO TURN OFF
65 MS TURN ON TD
OVER AND UNDER VOLT DETECTOR
200 MS TD
PS NO 2 OFF
PS NO 1 OFF
OFF SIG
PULSE DET
+5 VDC DET
+10 VDC DET
-20 VDC DET
+20 VDC DET
NO 1 POWER SUPPLY
NO 2 POWER SUPPLY
+5 V REG
+10 V REG
-20 V REG
+20 V REG
+5 VDC
+10 VDC
-20 VDC
+20 VDC
CT0016V SCE NEG SUPPLY VOLTS 0 TO -30 VDC 10 S/S 1 S/S
CT0015V SCE POS SUPPLY VOLTS 0 TO +30 VDC 10 S/S 1 S/S
DC ACTIVE ATTENUATOR (AA)
CC0206V
CC0207V
CC0210V
CC0211V
CC0232V
SF0266X
CH3635X
CH3636X
CH3638X
CH3639X
CH3641X
CH3642X
BS0080X
BS0081X
CS0150X
DC DIFFERENTIAL AMPLIFIER (DA)
CC0215C
CC0222C
CC0223C
CC0224C
SC2113C
SC2114C
SC2115C
CC2962C
* BS0050P
* BS0051P
* BS0052P
* BS0053P
DC DIFFERENTIAL BRIDGE AMPLIFIER (DBA)
CC0175T
CC0176T
CC0177T
SC2081T
SC2082T
SC2083T
SC2084T
SC2085T
SC2086T
SP0061T
SP0062T
AC TO DC CONVERTER (AC)
CC0200V
CC0203V
INSTRUMENTATION JUNCTION BOX
DISPL
CAUT


G
F
E
DATA STORAGE EQUIPMENT (DSE) C13-1A107
SPARE
ANALOG NO 7
ANALOG NO 6
ANALOG NO 5
ANALOG NO 4
SCI ANALOG NO 3
SCI ANALOG NO 2
SCI ANALOG NO 1
LM PCM
LM/INTERCOM VOICE
TRK 2
TRK 4
TRK 6
TRK 8
TRK 14
TRK 13
TRK 12
TRK 11
TRK 10
RECORD
PLAYBACK
RECORD AND PLAYBACK ELECTRONICS PWR
PWR TO RECORD CIRCUITS
PWR TO PLAYBACK CIRCUITS
15 IPS AMPL GAIN CNTL
120 IPS AMPL GAIN CNTL
ENABLE ERASE AMPL
51.2 KBPS NRZ-C PCM DATA
PLAYBACK CONVERTER
DIGITAL DATA SHIFT REGISTER AND SWITCHING CONVERTER
RECORD CONVERTER
RECORD AND PLAYBACK ELECTRONICS
DATA
CLOCK
TRK 9
TRK 7
TRK 5
TRK 3
TRK 1
DATA RATE CLOCK
TAPE MOTION SENSOR ELECTRONICS
PWR
ELECT PWR
+28 VDC
POWER SUPPLY AND REG
3φ PWR
REEL
CAPSTAN
TAPE DRIVE CONTROL
FWD
REV
RCD
PLAY
OFF
ON
K7 PWR OFF
K7 PWR ON
RD
K3 ELECT ON
K3 ELECT OFF
K4 PLAY
K4 RECORD
3.75 IPS CMD
15 IPS CMD
PCM/ANLG
K2 15 IPS PLAY
K2 120 IPS PLAY
0.8 KHZ BP FILTER
AC DETECTOR
51.2 KHZ BP FILTER
PLAYBACK - DATA RATE TIMING
512 KHZ VOICE AND EMERGENCY KEY SUBCARRIER REFERENCE
DATA RATE INDICATOR (5.5 VDC = HBR)
NRZ - C PCM DATA
512 KHZ PCM SUBCARRIER REFERENCE
PCM
BIT RATE
15 IPS RECORD CMD
3.75 IPS RECORD CMD
LBR CMD
HIGH
LOW
MDC 3
S55
71
64
70
65
UDL
6,5
BIT RATE COMM
BIT RATE HIGH - -
BIT RATE LOW - -
BIT RATE RESET -
3φ PWR
3φ PWR
POWER SUPPLY A
POWER SUPPLY B
POWER TO ALL UNITS
OUTPUT SHIFT REGISTER
DIGITAL MULTI-PLEXER
DATA
BILEVEL SIGNALS
SIGNALS
ANALOG CODER
TIMING AND CONTROL
HIGH SPEED GATES
PAM 1
PAM 2
PAM 3
ANALOG MULTI-PLEXER
ANALOG SIGNALS
IRECT 0 TO 5 VDC
NALOG SIGNALS
PROGRAMER
INT CLOCK 512KHZ
PCM EQUIPMENT
C13-1A101
CALIBRATOR
SIGNALS
AND WARNING SIGNALS
DWG 7.3
MENTATION PARAMETERS
NG DISTRIBUTION TO C&W,
Y, AND/OR PCM
4.25 VDC
0.75 VDC
CT0125V PCM HI LEV 85% REF 0 TO 5 VDC 10 S/S 1 S/S
CT0126V PCM HI LEV 15% REF 0 TO 1.0 VDC 10 S/S 1 S/S
CT0340X PCM SYNC SOURCE EXT OR INT 1 - EXT 10 S/S
CT0120X PCM BIT RATE CHG 8 BITS 1 S/S 1 S/S
DATA RATE INDICATOR (5.5 VDC = HBR)
512 KHZ TIMING
1 PPS FRAME SYNC
UPDATA LINK
C28-1A103
DWG 6.5
RESET
SEC ADVANCE
MIN ADVANCE
HR ADVANCE
DAY ADVANCE
TO SCI CONNECTOR J126 LEB 163
START PULSE
DATA CLOCK
STOP PULSE
CMC SERIAL DATA
COMMAND MODULE COMPUTER (CMC)
8,1
1024 KHZ TIMING


D
C
B
A
LTR | DR | ENGR | DATE | APPROVAL
30 PWR
CT0012X
DSE TAPE MOTION
MOTION
10 S/S
1 S/S
END OF TAPE SENSORS
REV
FWD
DC CNTL PWR
C Z5 6.4
PWR TO S-BAND FM XMTR CNTL CIRCUIT
TAPE RECORDER
S-BAND FM XMTR
DATA STORAGE EQUIP
FLT BUS
5A
RHEB 225
CB13
VF
FWD
DIFF
REWIND
77
72
76
73
UDL
Q Z1 6.5
DSE CONTROL COMMANDS:
DSE TAPE FORWARD - - 72, 77
DSE TAPE STOP - - - - 73, 76
DSE TAPE REWIND - - - 73, 77
TAPE CNTL RESET - - - 72, 76
MDC 3
S51
100 MS PULSE
TAPE MOTION
(GRAY = MOTION)
DS22
67
62
66
63
57
52
56
53
DSE ELECT COMMANDS:
DSE ELECT RECORD - - - - 62, 67
DSE ELECT OFF - - - - - - - 63, 66
DSE ELECT PLAYBACK - - - 63, 67
DSE ELECT RESET - - - - - 62, 66
RCD
PWR
PLAY
RECORD
PLAY
MDC 3
S50
120 IPS CLUTCH
15 IPS CLUTCH
IF NEITHER CLUTCH POWERED, TAPE WILL MOVE AT 3.75 IPS
BACK (AUTO SPEED CNTL ENABLED)
M PLAYBACK AT 120 IPS
CSM PCM
LM PCM
PLAYBACK MODE COMMANDS:
SELECT CSM P/B DATA - 52, 57
SELECT LM P/B DATA - 53
P/B MODE RESET - - - 52, 56
S-BAND FM SUBCARRIER CONTROL SIGNALS PMP
E Z7 6.4
PCM/ANLG
LM PCM
MDC 3
S49
71
70
6.4 KHZ SYNC TO AC PWR INVERTERS
C Z8 4.2
1 PULSE/10 MIN TO ECS H2O ACCUMULATOR
B Z4 11.3
10 PPS SYNC TO EVENT TIMERS
E Z8 3.3
E Z4 3.3
E Z1 3.3
INV 1
INV 2
INV 3
BUFFER AMPLIFIERS
512 KHZ
1 PPS
10 PPS
6.4 KHZ
÷10
÷64
÷8
÷4
UDL RESET
SCHMITT TRIGGER
MIXER
2048 KHZ
TEMP CONTROL OSC
2048 KHZ
PHASE LOCK SYNC
POWER SUPPLY NO 3
POWER SUPPLY NO 2
POWER TO ALL UNITS
CTE DATA XFER GATES
RAL TIMING EQUIPMENT (CTE) C28-1A102
CENTRAL TIMING EQUIP
MNA
5A
RHEB 225
CB21
VMA
MNB
5A
RHEB 225
CB22
VMB
NOTES:
2 SEE PCM TELEMETRY TABLES IN THIS SECTION FOR PARTICULAR PARAMETER DATA. PARAMETERS WITH AN * WILL NOT APPEAR IN PCM TELEMETRY TABLE AS THEY ARE ON BOARD DISPLAY ONLY
1 FOR PCM INSTRUMENTATION POWER DISTRIBUTION SEE PARAMETER LIST THIS SECTION
1 INSTR
SIGNATURES
DR
DSGN
QC
ENGR
NR
APP
PEC
AUTH
DATE
NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS
INSTRUMENTATION POWER AND CONTROL
CSM 104
SIZE J
DWG NO 7.1
34 X 82.5
PAGE
SHEET OF

HBR FORMAT

(6400 WORDS/SEC)

START	SYNC 1 (51DP1A)	A	SYNC 2 (51DP1B)	A	SYNC 3 (51DP1C)	A	SYNC 4 & FRAME COUNT (51DP1D)	A	22A1	A	22A2	A	22A3	A	22A4	A							
	1		2		3		4		5		6		7		8								
	11A1 11A37 11A73 11A109 9 11A145	B C D E F	11A2 11A38 11A74 11A110 10 11A146	B C D E F	11A3 11A39 11A75 11A111 11 11A147	B C D E F	11A4 11A40 11A76 11A112 12 11A148	B C D E F	12A1	A	12A2	A	12A3	A	12A4	A							
	11A5 11A41 11A77 11A113 17 11A149	I C H I	22DP1	A	22DP2	A	10DP1 SRC "0" SRC "1" 20	1 C U 4 T 5C	12A5	A	12A6	A	12A7	A	12A8	A							
	11A6 11A42 11A78 11A114 25 11A150	I C H I	11A7 11A43 11A79 11A115 26 11A151	B C D E F	11A8 11A44 11A88 11A116 27 11A152	B C D E F	11A9 11A45 11A81 11A117 28 11A153	B C D E F	51A1	A	51A2	A	51A3	A	51DS1A	A							
	51DS1B	A	51DS1C	A	51DS1D	A	51DS1E	A	22A1	A	22A2	A	22A3	A	22A4	A							
	33		34		35		36		37		38		39		40								
	11A10 11A46 11A82 11A118 41 11A154	B C D E F	11A11 11A47 11A83 11A119 42 11A155	B C D E F	11A12 11A48 11A84 11A120 43 11A156	B C D E F	11A13 11A49 11A85 11A121 44 11A157	B C D E F	12A9	A	12A10	A	12A11	A	12A12	A							
	11A14 11A50 11A86 11A122 49 11A158	B C D E F	22DP1	A	22DP2	A	10A1 10A4 10A7 52 10A148	1 2 3 5C	12A13	A	12A14	A	12A15	A	12A16	A							
	11A15 11A51 11A87 11A123 57 11A159	B C D E F	11A16 11A52 11A88 11A124 58 11A160	B C D E F	11A17 11A53 11A89 11A125 59 11A161	B C D E F	11A18 11A54 11A90 11A126 60 11A162	B C D E F	51A4	A	51A5	A	51A6	A	51A7	A							
	11DP2A 11DP 6 11DP13 11DP20 65 11DP27	B C D E F	11DP2B 11DP 7 11DP14 11DP21 66 11DP28	B C D E F	11DP2C 11DP8 11DP15 11DP22 67 11DP29	B C D E F	11DP2D 11DP9 11DP16 11DP23 68 11DP30	B C D E F	22A1	A	22A2	A	22A3	A	22A4	A							
	11A19 11A55 11A91 11A127 73 11A163	B C D E F	11A20 11A56 11A92 11A128 74 11A164	B C D E F	11A21 11A57 11A93 11A129 75 11A165	B C D E F	11A22 11A58 11A94 11A130 76 11A166	B C D E F	12A1	A	12A2	A	12A3	A	12A4	A							
	11A23 11A59 11A95 11A131 81 11A167	B C D E F	22DP1		22DP2		10A2 10A5 10A8 84 10A149	1 2 3 5C	12A5	A	12A6	A	12A7	A	12A8	A							
	11A24 11A60 11A96 11A132 89 11A168	B C D E F	11A25 11A61 11A97 11A133 90 11A169	B C D E F	11A26 11A62 11A98 11A134 91 11A170	B C D E F	11A27 11A63 11A99 11A135 92 11A171	B C D E F	51A8	A	51A9	A	51A10	A	51A11	A							
	11DP3 11DP10 11DP17 11DP24 97 11DP31	B C D E F	11DP4 11DP11 11DP18 11DP25 98 11DP32	B C D E F	11DP5 11DP12 11DP19 11DP26 99 11DP33	B C D E F	51DP2 100	A	22A1	A	22A2	A	22A3	A	22A4	A							
	11A28 11A64 11A100 11A136 105 11A172	B C D E F	11A29 11A65 11A101 11A137 106 11A173	B C D E F	11A30 11A66 11A102 11A138 107 11A174	B C D E F	11A31 11A67 11A103 11A139 108 11A175	B C D E F	12A9	A	12A10	A	12A11	A	12A12	A							
	11A32 11A68 11A104 11A140 113 11A176	B C D E F	22DP1	A	22DP2	A	10A3 10A6 10A8 116 10A150	1 2 3 5C	12A13	A	12A14	A	12A15	A	12A16	A							
	11A33 11A69 11A105 11A141 121 11A177	B C D E F	11A34 11A70 11A106 11A142 122 11A178	B C D E F	11A35 11A71 11A107 11A143 123 11A179	B C D E F	11A36 11A72 11A108 11A144 124 11A180	B C D E F	51A12	A	51A13	A	51A14	A	51A15	A							
									125		126		127		128								

THE FOLLOWING LETTER CODE DESIGNATES HBR PRIME FRAMES FOR CHANNELS SAMPLED IN MORE THAN ONE PRIME FRAME:

- A ALL PRIME FRAMES (1 THRU 50)
- B PRIME FRAMES 1,6,11,--46
- C PRIME FRAMES 2,7,12,--47
- D PRIME FRAMES 3,8,13,--48
- E PRIME FRAMES 4,9,14,--49
- F PRIME FRAMES 5,10,15,-50

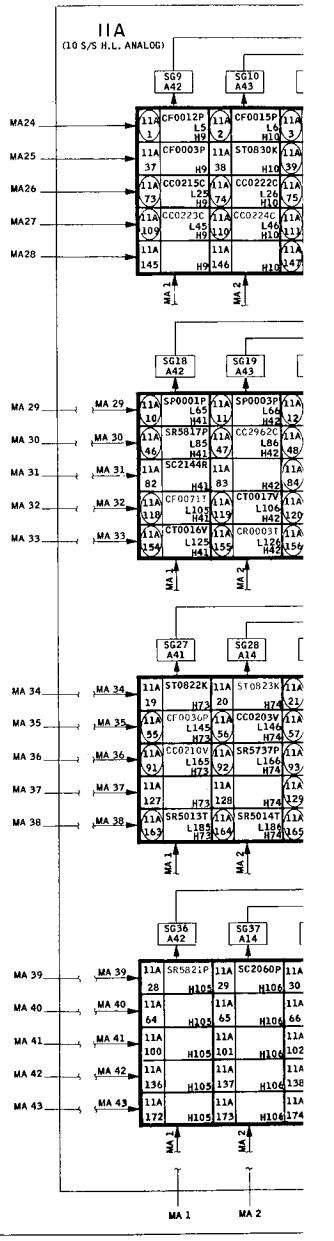
LBR FORMAT

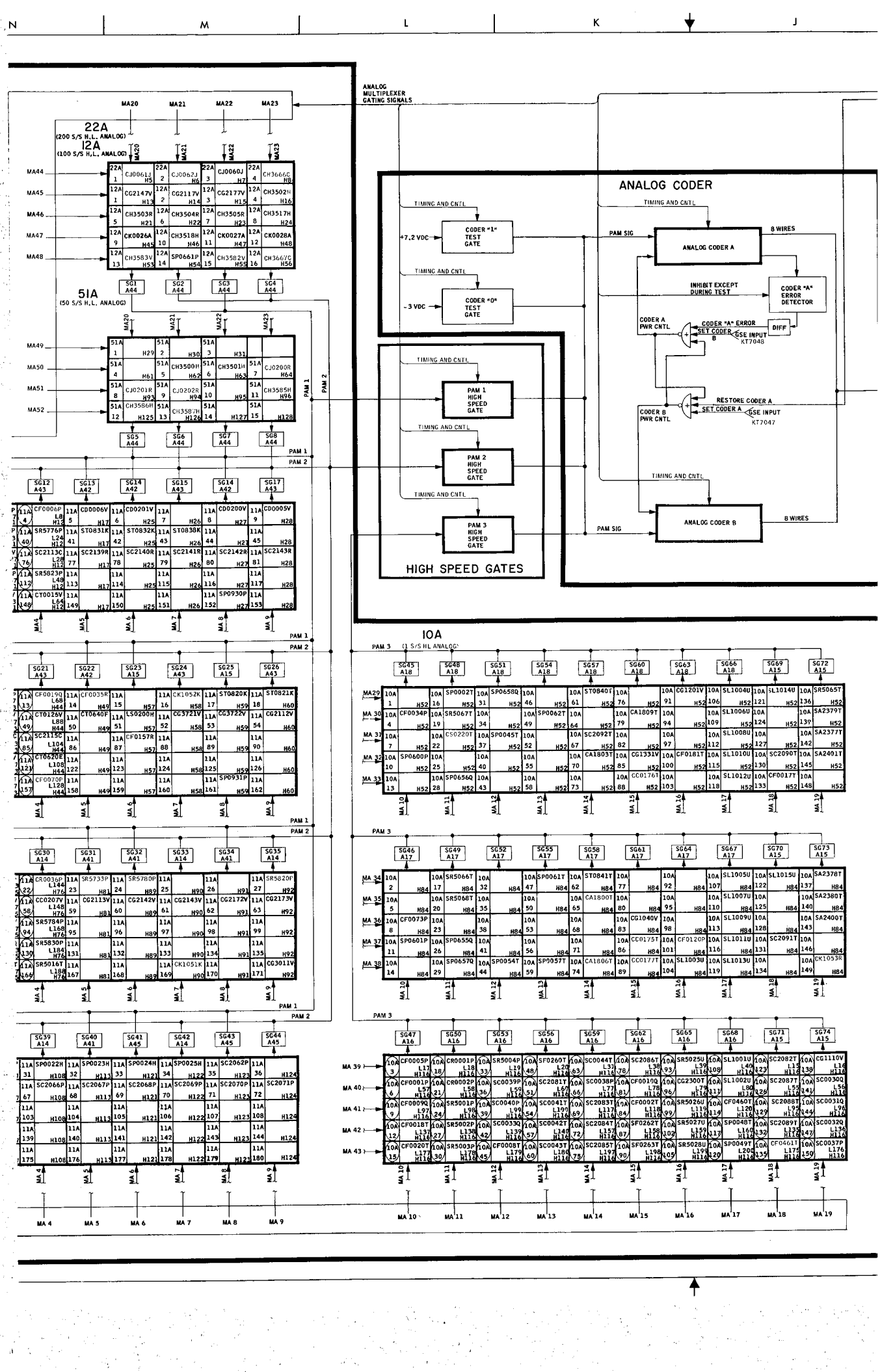
(200 WORDS/SEC)

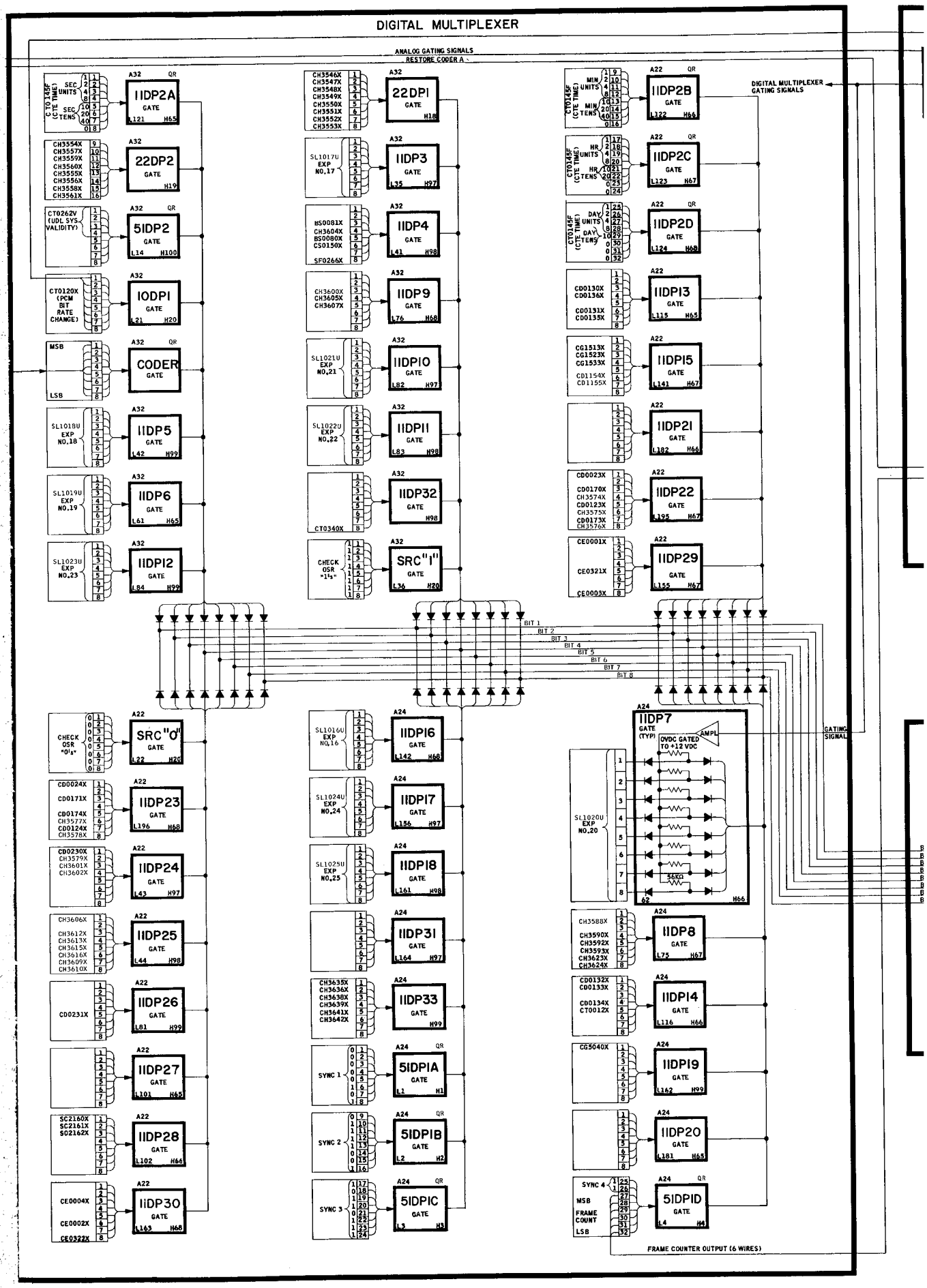
START	WD	CHAN	WD	CHAN	WD	CHAN	WD	CHAN	WD	CHAN	WD	CHAN	WD	CHAN	WD	CHAN	WD	CHAN	WD	CHAN
	1 41 81 121 161	51DP1A 11DP4 11DP26 11DP2A 11DP18	2 42 82 122 162	51DP1B 11DP5 11DP10 11DP28 11DP19	3 43 83 123 163	51DP1C 11DP24 11DP11 11DP2C 11DP30	4 44 84 124 164	51DP1D 11DP25 11DP12 11DP2D 11DP31	5 45 85 125 165	11A1 11A109 11A46 11A154 11A91	6 46 86 126 166	11A2 11A110 11A47 11A155 11A92	7 47 87 127 167	11A3 11A111 11A48 11A156 11A93	8 48 88 128 168	11A4 11A112 11A49 11A157 11A94	9 49 89 129 169	51DS1A	10 50 90 130 170	51DS1B
	11 51 91 131 171	51DS1C	12 52 92 132 172	51DS1D	13 53 93 133 173	51DS1E	14 54 94 134 174	51DP2	15 55 95 135 175	10A123 10A126 10A129 10A132 10A135	16 56 96 136 176	10A138 10A141 10A144 10A147 10A150	17 57 97 137 177	10A3 10A6 10A9 10A12 10A15	18 58 98 138 178	10A18 10A21 10A24 10A27 10A30	19 59 99 139 179	10A33 10A36 10A39 10A42 10A45	20 60 100 140 180	10A48 10A51 10A54 10A57 10A60
	21 61 101 141 181	10DP1 11DP6 11DP27 11DP15 11DP20	22 SRC "0" 62 11DP7 102 11DP25 142 11DP16 182 11DP21		23 63 103 143 183	11A39 11A147 11A84 11A21 11A129	24 64 104 144 184	11A40 11A148 11A85 11A22 11A130	25 65 105 145 185	11A73 11A10 11A118 11A55 11A163	26 66 106 146 186	11A74 11A11 11A119 11A56 11A164	27 67 107 147 187	11A75 11A12 11A120 11A57 11A165	28 68 108 148 188	11A76 11A13 11A121 11A58 11A166	29 69 109 149 189	51DS1A	30 70 110 150 190	51DS1B
	31 71 111 151 191	51DS1G	32 72 112 152 192	51DS1D	33 73 113 153 193	51DS1E	34 74 114 154 194	51DP2	35 75 115 155 195	11DP3 11DP8 11DP13 11DP29 11DP22	36 76 116 156 196	SRC "1" 11DP9 11DP14 11DP17 11DP23	37 77 117 157 197	10A63 10A66 10A69 10A72 10A75	38 78 118 158 198	10A78 10A81 10A84 10A87 10A90	39 79 119 159 199	10A93 10A96 10A99 10A102 10A105	40 80 120 160 200	10A108 10A111 10A114 10A117 10A120

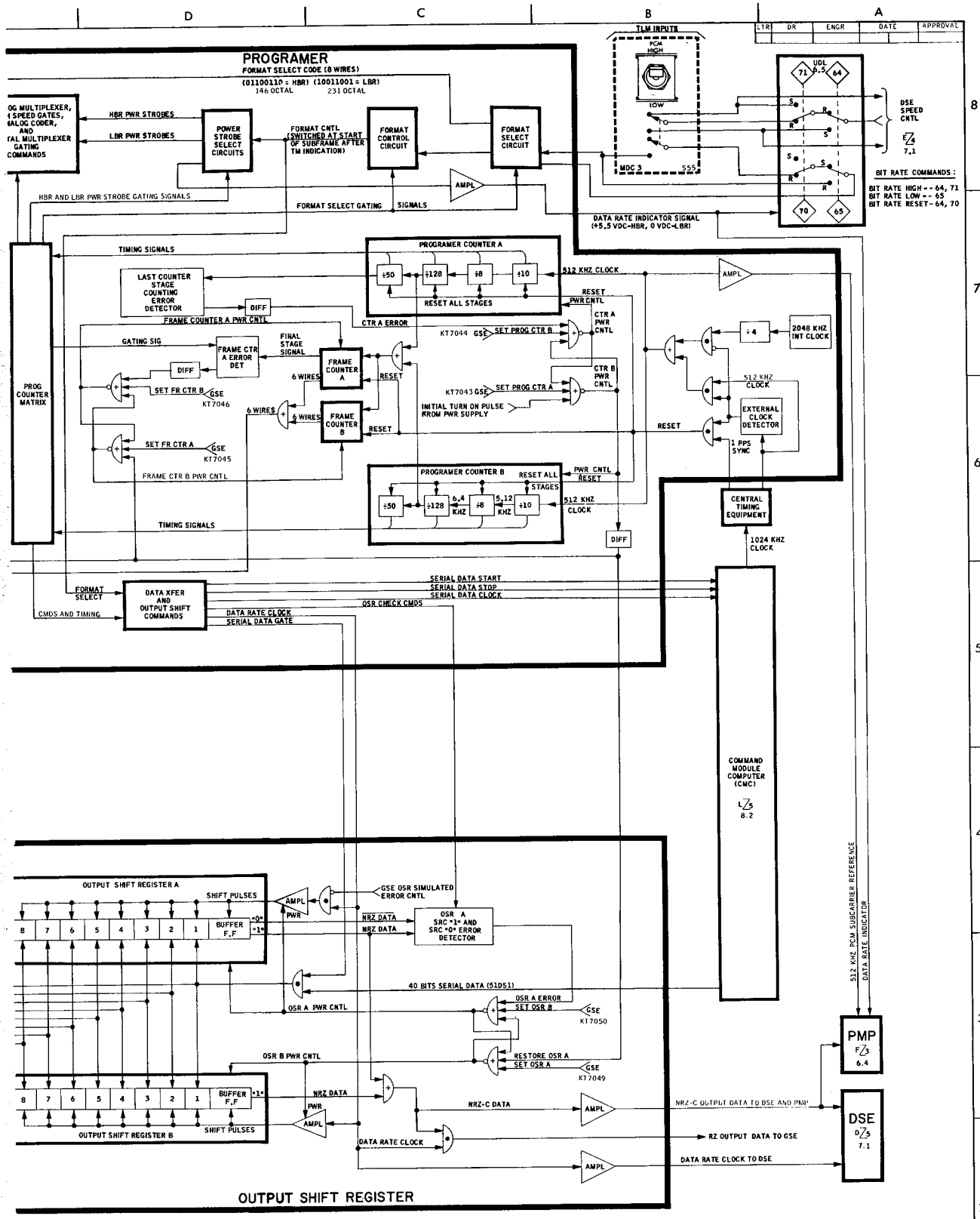
ANALOG MULTIPLEXER

ANALOG GATE DRIVERS




N
M
L
K
J
ANALOG MULTIPLEXER GATING SIGNALS
MA20
MA21
MA22
MA23
22A
(200 S/S H.L. ANALOG)
12A
(100 S/S H.L. ANALOG)
51A
(50 S/S H.L. ANALOG)
ANALOG CODER
TIMING AND CNTL
+7.2 VDC
CODER "1" TEST GATE
-3 VDC
CODER "0" TEST GATE
PAM SIG
ANALOG CODER A
8 WIRES
INHIBIT EXCEPT DURING TEST
CODER "A" ERROR DETECTOR
CODER A PWR CNTL
CODER "A" ERROR SET CODER B
DIFF
GSE INPUT KT7048
PAM 1 HIGH SPEED GATE
PAM 2 HIGH SPEED GATE
PAM 3 HIGH SPEED GATE
HIGH SPEED GATES
RESTORE CODER A SET CODER A
GSE INPUT KT7047
CODER B PWR CNTL
ANALOG CODER B
10A
PAM 3
(1 S/S HL ANALOG)
PAM 1
PAM 2


DIGITAL MULTIPLEXER
ANALOG GATING SIGNALS
RESTORE CODER A
DIGITAL MULTIPLEXER GATING SIGNALS
GATING SIGNAL
FRAME COUNTER OUTPUT (6 WIRES)
BIT 1
BIT 2
BIT 3
BIT 4
BIT 5
BIT 6
BIT 7
BIT 8
11DP2A
22DP2
5IDP2
10DP1
CODER
11DP5
11DP6
11DP12
SRC"0"
11DP23
11DP24
11DP25
11DP26
11DP27
11DP28
11DP30
22DP1
11DP3
11DP4
11DP9
11DP10
11DP11
11DP32
SRC"1"
11DP16
11DP17
11DP18
11DP31
11DP33
5IDP1A
5IDP1B
5IDP1C
11DP2B
11DP2C
11DP2D
11DP13
11DP15
11DP21
11DP22
11DP29
11DP7
11DP8
11DP14
11DP19
11DP20
5IDP1D
SEC UNITS
SEC TENS
MSB
LSB
CHECK OSR "0's"
CHECK OSR "1's"
SYNC 1
SYNC 2
SYNC 3
SYNC 4
MIN UNITS
MIN TENS
HR UNITS
HR TENS
DAY UNITS
DAY TENS
FRAME COUNT
SL1016U EXP NO.16
SL1017U EXP NO.17
SL1018U EXP NO.18
SL1019U EXP NO.19
SL1020U EXP NO.20
SL1021U EXP NO.21
SL1022U EXP NO.22
SL1023U EXP NO.23
SL1024U EXP NO.24
SL1025U EXP NO.25
CT0262V (UDL SYS VALIDITY)
CT0120X (PCM BIT RATE CHANGE)
CT0340X
CT0145F (CTE TIME)
CH3546X
CH3547X
CH3548X
CH3549X
CH3550X
CH3551X
CH3552X
CH3553X
CH3554X
CH3557X
CH3559X
CH3560X
CH3555X
CH3556X
CH3558X
CH3561X
BS0081X
CH3604X
BS0080X
CS0150X
SF0266X
CH3600X
CH3605X
CH3607X
CD0130X
CD0136X
CD0131X
CD0135X
CG1513X
CG1523X
CG1533X
CD1154X
CD1155X
CD0023X
CD0170X
CH3574X
CD0123X
CH3575X
CD0173X
CH3576X
CE0001X
CE0321X
CE0003X
CD0024X
CD0171X
CD0174X
CH3577X
CD0124X
CH3578X
CD0230X
CH3579X
CH3601X
CH3602X
CH3606X
CH3612X
CH3613X
CH3615X
CH3616X
CH3609X
CH3610X
CD0231X
SC2160X
SC2161X
SC2162X
CE0004X
CE0002X
CE0322X
CH3588X
CH3590X
CH3592X
CH3593X
CH3623X
CH3624X
CD0132X
CD0133X
CD0134X
CT0012X
CG5040X
5VDC GATED TO +12 VDC
AMPL
54KΩ
GATE
(TYP)



7 SRC "0" WILL APPEAR IN WORD 20 PRIME FRAMES 2, 7, 12, 17..... 47 AND SRC "1" WILL APPEAR IN WORD 20 PRIME FRAMES 3, 8, 13, 18..... 48

6. ENCIRCLED CHANNEL CODE NUMBERS INDICATE ANALOG CHANNELS APPEARING IN LBR FORMAT
5. EVENT PARAMETERS DESIGNATED XXEXX-XX WILL BE GATED BY CORRESPONDING XXDPXX GATE
4. AXX DESIGNATES PRINTED CIRCUIT MODULE LOCATION INTERNAL TO PCM
3. SGXX DESIGNATES SEQUENCER GATE NUMBER
2. HXXX DESIGNATES HBR WORD NUMBER

NOTES: 1. LXXX DESIGNATES LBR WORD NUMBER

2 PCM

SIGNATURES	DATE
DR	
DSGN	
QC	
ENGR	
NR	
APP	
FEC	
AUTH	

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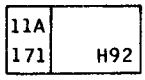
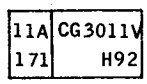
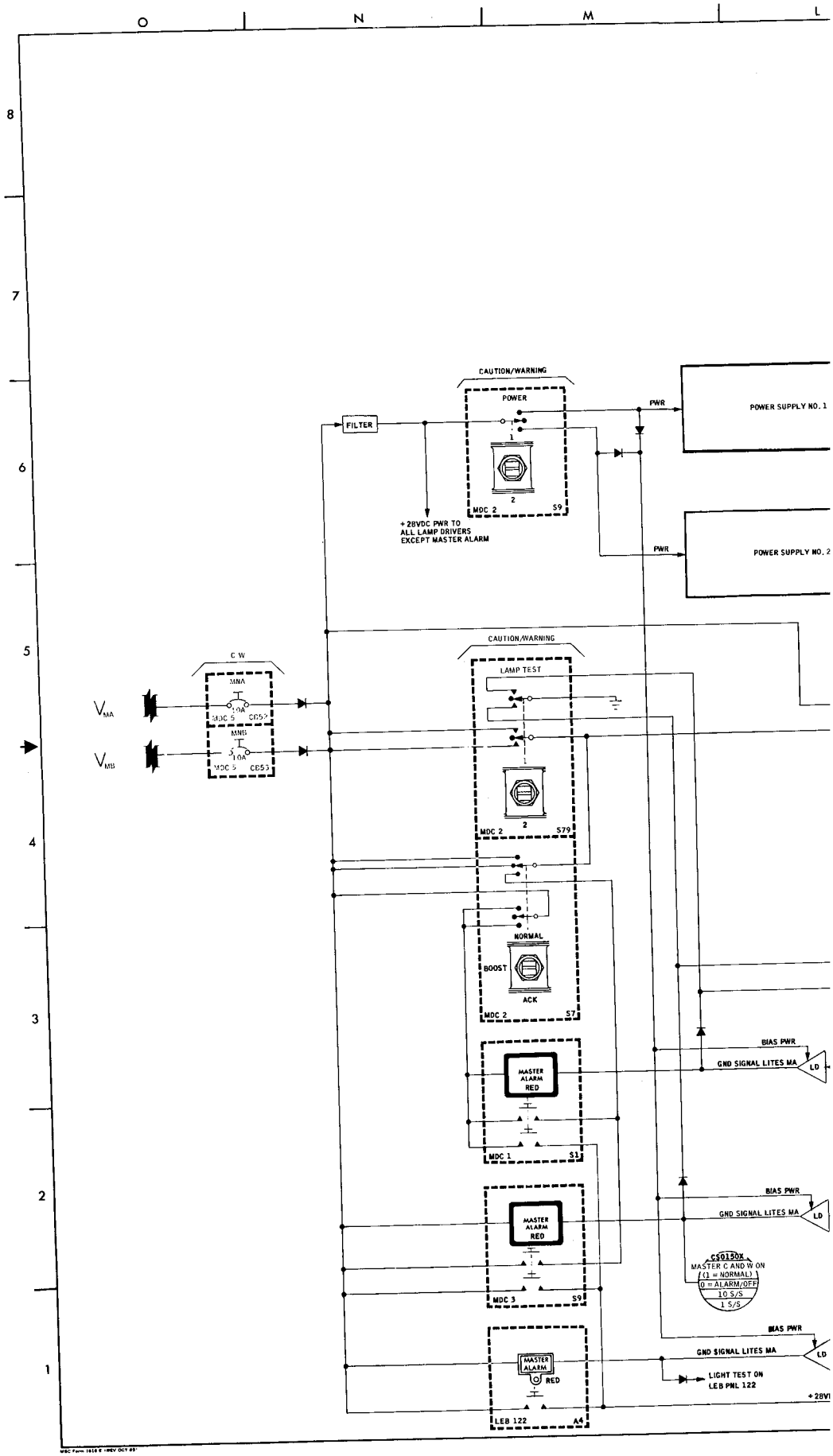
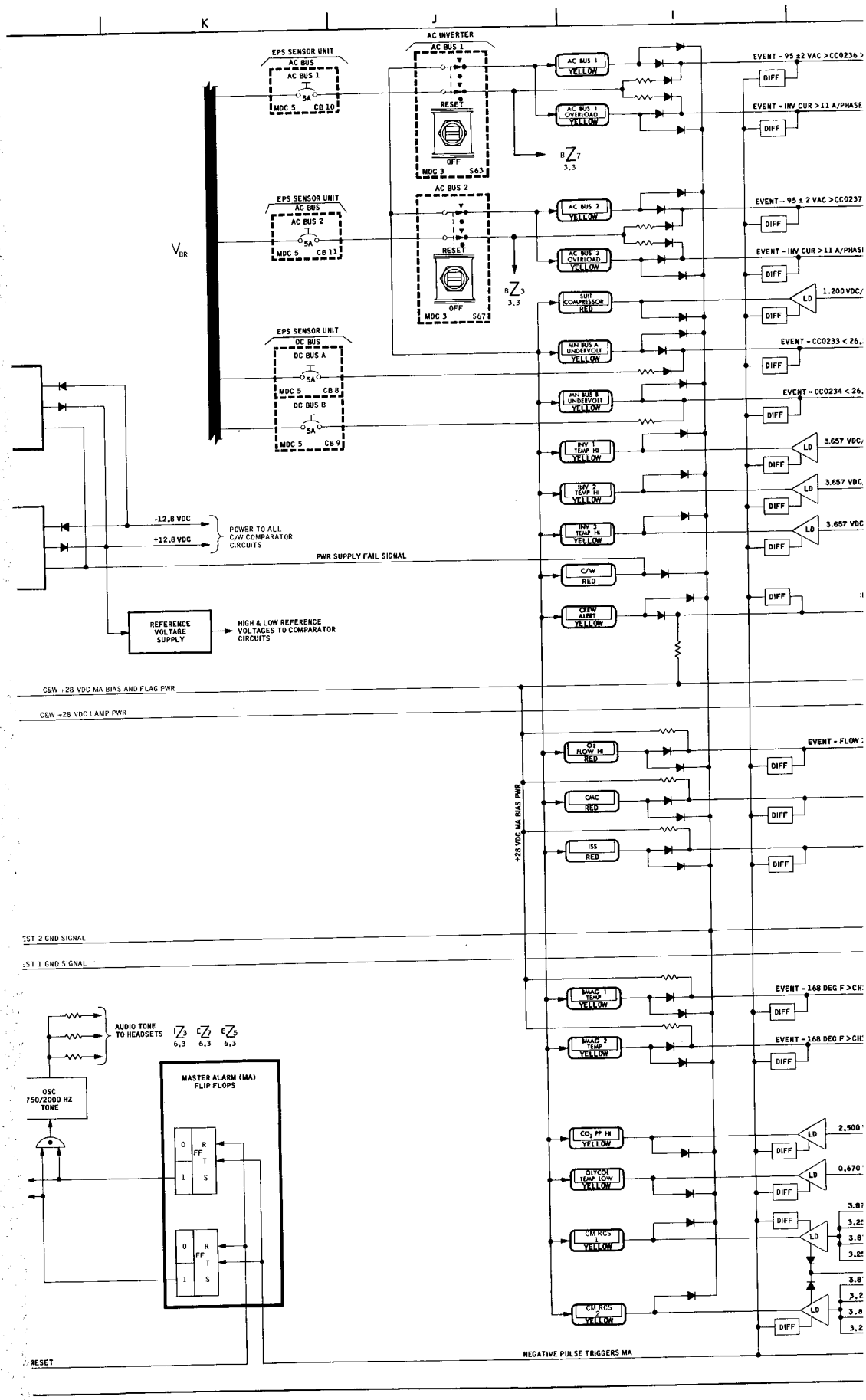
INSTRUMENTATION
PCM SIGNAL FLOW

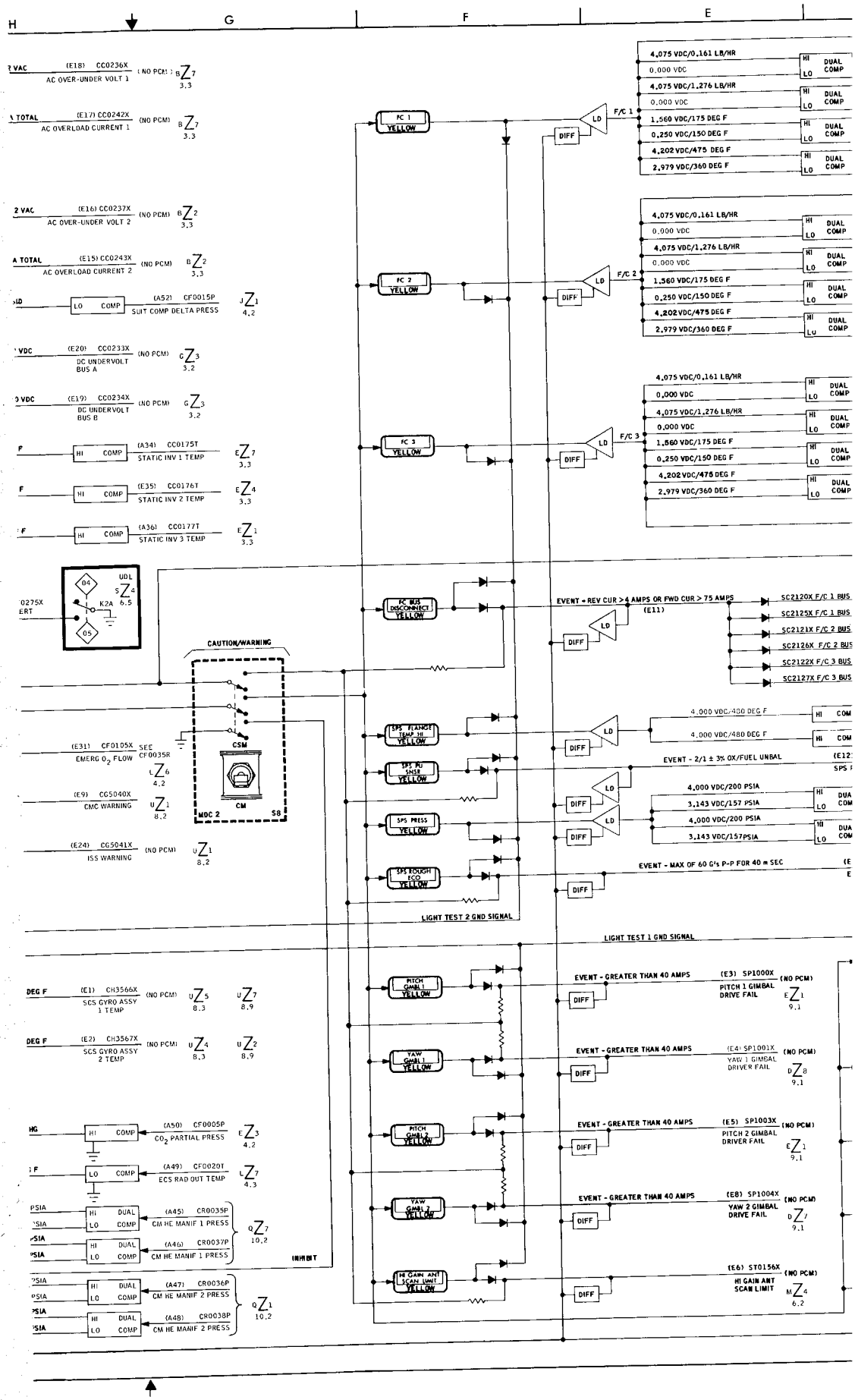
CSM 104 | SIZE J | DWG NO 7.2 | 9½ X 34 | SHEET 1 OF 1

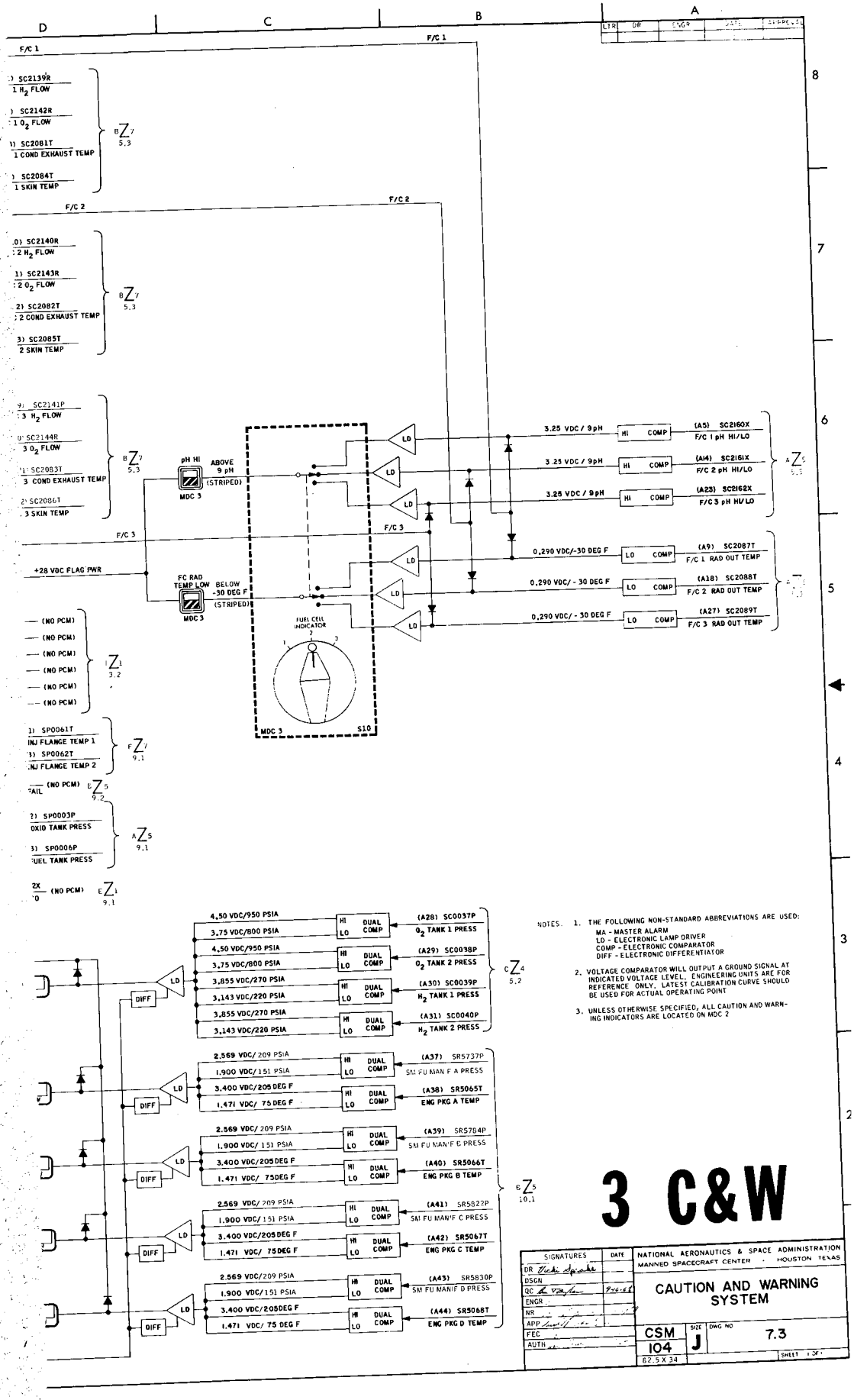
SECTION 7

IS	WAS
1. DWG 7.2 M Z 6	
2. DWG 7.2 M Z 3	
	
3. DWG 7.2 J Z 2	
SR5025Q	SR5025U
SR5026Q	SR5026U
SR5027Q	SR5027U
SR5028Q	SR5028U


O
N
M
L
8
7
6
5
4
3
2
1
CAUTION/WARNING
POWER
FILTER
PWR
POWER SUPPLY NO. 1
POWER SUPPLY NO. 2
MDC 2
S9
+28VDC PWR TO
ALL LAMP DRIVERS
EXCEPT MASTER ALARM
C W
MNA
MNB
10A
MDC 5
CB52
CB53
V_{MA}
V_{MB}
CAUTION/WARNING
LAMP TEST
MDC 2
S79
NORMAL
BOOST
ACK
MDC 2
S7
BIAS PWR
GND SIGNAL LITES MA
LD
MASTER ALARM
RED
MDC 1
S1
MASTER ALARM
RED
MDC 3
S9
CS0130X
MASTER C AND W ON
(1 = NORMAL)
0 = ALARM/OFF
10 S/S
1 S/S
MASTER ALARM
RED
LEB 122
A4
LIGHT TEST ON
LEB PNL 122
+28VI


K
J
I
AC INVERTER
EPS SENSOR UNIT
AC BUS
AC BUS 1
5A
MDC 5 CB 10
AC BUS 1
RESET
OFF
MDC 3 S63
AC BUS 2
MDC 5 CB 11
MDC 3 S67
DC BUS
DC BUS A
MDC 5 CB 8
DC BUS B
MDC 5 CB 9
V_{BR}
$_{B}Z_{7}$ 3,3
$_{B}Z_{3}$ 3,3
AC BUS 1 YELLOW
AC BUS 1 OVERLOAD YELLOW
AC BUS 2 YELLOW
AC BUS 2 OVERLOAD YELLOW
SUIT COMPRESSOR RED
MN BUS A UNDERVOLT YELLOW
MN BUS B UNDERVOLT YELLOW
INV 1 TEMP HI YELLOW
INV 2 TEMP HI YELLOW
INV 3 TEMP HI YELLOW
C/W RED
C&W ALERT YELLOW
DIFF
LD
EVENT - 95 ±2 VAC >CC0236
EVENT - INV CUR >11 A/PHASE
EVENT - 95 ± 2 VAC >CC0237
EVENT - INV CUR >11 A/PHASE
1.200 VDC/
EVENT - CC0233 < 26.
EVENT - CC0234 < 26.
3.657 VDC/
3.657 VDC
3.657 VDC
-12.8 VDC
+12.8 VDC
POWER TO ALL C/W COMPARATOR CIRCUITS
PWR SUPPLY FAIL SIGNAL
REFERENCE VOLTAGE SUPPLY
HIGH & LOW REFERENCE VOLTAGES TO COMPARATOR CIRCUITS
C&W +28 VDC MA BIAS AND FLAG PWR
C&W +28 VDC LAMP PWR
+28 VDC MA BIAS PWR
O2 FLOW HI RED
CMC RED
ISS RED
EVENT - FLOW
EST 2 GND SIGNAL
EST 1 GND SIGNAL
AUDIO TONE TO HEADSETS
$_{I}Z_{3}$ 6,3
$_{E}Z_{7}$ 6,3
$_{E}Z_{5}$ 6,3
OSC 750/2000 HZ TONE
MASTER ALARM (MA) FLIP FLOPS
0
1
RESET
SET
BMAG 1 TEMP YELLOW
BMAG 2 TEMP YELLOW
EVENT - 168 DEG F >CH
CO_2 PP HI YELLOW
GLYCOL TEMP LOW YELLOW
CM RCS 1 YELLOW
CM RCS 2 YELLOW
2.500
0.670
NEGATIVE PULSE TRIGGERS MA
RESET


H
G
F
E
AC OVER-UNDER VOLT 1
AC OVERLOAD CURRENT 1
AC OVER-UNDER VOLT 2
AC OVERLOAD CURRENT 2
SUIT COMP DELTA PRESS
DC UNDERVOLT BUS A
DC UNDERVOLT BUS B
STATIC INV 1 TEMP
STATIC INV 2 TEMP
STATIC INV 3 TEMP
EMERG O2 FLOW
CMC WARNING
ISS WARNING
SCS GYRO ASSY 1 TEMP
SCS GYRO ASSY 2 TEMP
CO2 PARTIAL PRESS
ECS RAD OUT TEMP
CM HE MANIF 1 PRESS
CM HE MANIF 2 PRESS
FC 1 YELLOW
FC 2 YELLOW
FC 3 YELLOW
FC BUS DISCONNECT YELLOW
SPS FLANGE TEMP HI YELLOW
SPS PU SNSR YELLOW
SPS PRESS YELLOW
SPS TOUGH ECO YELLOW
PITCH GMBL 1 YELLOW
YAW GMBL 1 YELLOW
PITCH GMBL 2 YELLOW
YAW GMBL 2 YELLOW
HI GAIN ANT SCAN LIMIT YELLOW
CAUTION/WARNING
CSM
CM
MDC 2
S8
LIGHT TEST 1 GND SIGNAL
LIGHT TEST 2 GND SIGNAL
EVENT - REV CUR > 4 AMPS OR FWD CUR > 75 AMPS
EVENT - 2/1 ± 3% OX/FUEL UNBAL
EVENT - MAX OF 60 G's P-P FOR 40 m SEC
EVENT - GREATER THAN 40 AMPS
PITCH 1 GIMBAL DRIVE FAIL
YAW 1 GIMBAL DRIVER FAIL
PITCH 2 GIMBAL DRIVER FAIL
YAW 2 GIMBAL DRIVE FAIL
HI GAIN ANT SCAN LIMIT
DIFF
LD
DUAL COMP
F/C 1
F/C 2
F/C 3



NOTES:

1. THE FOLLOWING NON-STANDARD ABBREVIATIONS ARE USED:
   MA - MASTER ALARM
   LD - ELECTRONIC LAMP DRIVER
   COMP - ELECTRONIC COMPARATOR
   DIFF - ELECTRONIC DIFFERENTIATOR
2. VOLTAGE COMPARATOR WILL OUTPUT A GROUND SIGNAL AT INDICATED VOLTAGE LEVEL. ENGINEERING UNITS ARE FOR REFERENCE ONLY. LATEST CALIBRATION CURVE SHOULD BE USED FOR ACTUAL OPERATING POINT
3. UNLESS OTHERWISE SPECIFIED, ALL CAUTION AND WARNING INDICATORS ARE LOCATED ON MDC 2

3 C&W

SIGNATURES	DATE
DR	
DSGN	
QC	
ENGR	
NR	
APP	
FEC	
AUTH	

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CAUTION AND WARNING SYSTEM

CSM 104 | SIZE J | DWG NO 7.3 | SHEET 1 OF 1

82.5 X 34

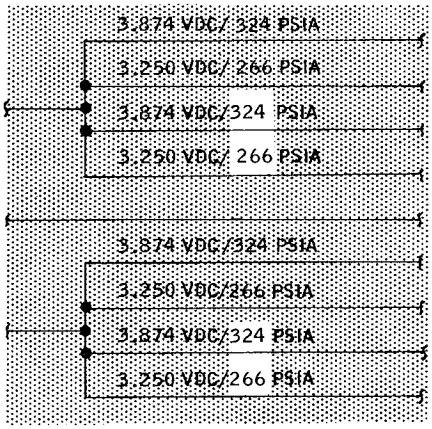
SECTION 7

IS

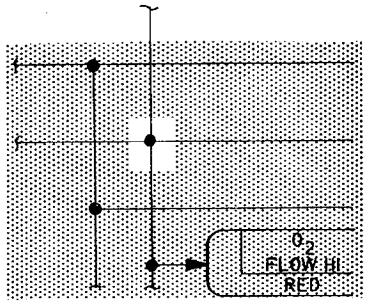
1. DWG 7.3 B Z 1

SR5823P

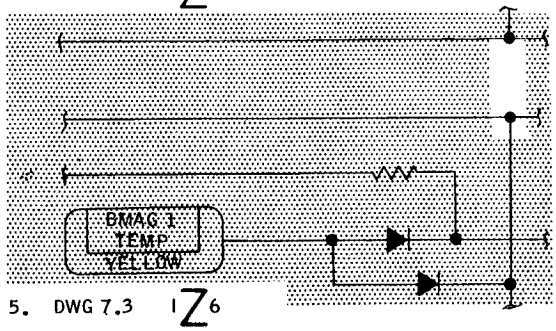
2. DWG 7.3 H Z 1



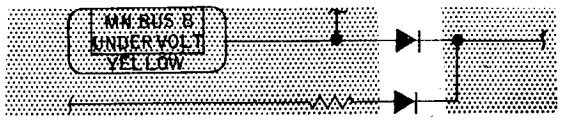
3. DWG 7.3 I Z 4



4. DWG 7.3 I Z 3

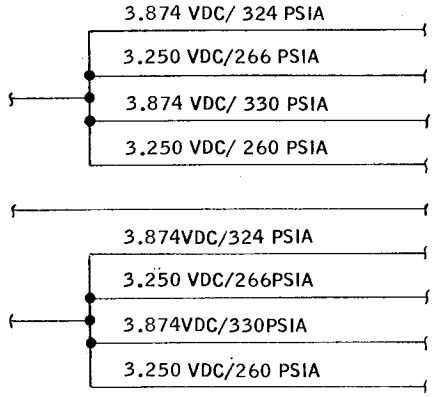


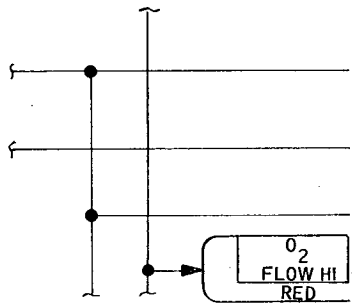
5. DWG 7.3 I Z 6

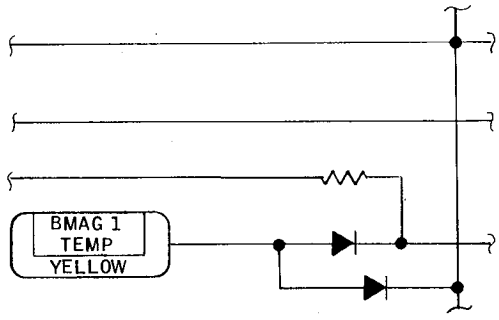


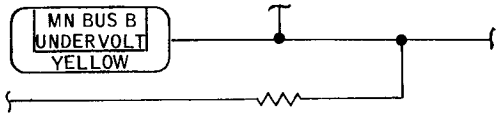
WAS

SR5830P









*

7.4 INSTRUMENTATION SYSTEM NOTES

7.4.1 PCM Signal Capabilities

Each analog and digital input to the PCM equipment is assigned to a channel and given a channel code number. A fixed program is provided for HBR and for LBR sampling. In HBR, all inputs will be sampled at least once during a subframe at sampling rates from 1 s/s to 200 s/s. In LBR, only selected inputs will be sampled during a subframe at a sample rate of 1 s/s (except channel codes 51DS1 [CMC parameters] and 51DP2 [UDL validity], which will be sampled at 10 s/s). The sampling sequence for HBR and for LBR are shown in the HBR format and LBR format respectively.

In the HBR mode, the PCM equipment is capable of handling the following input signals:

A. High Level Analog (0-5 Vdc) - 365 channels (4 at 200 s/s, 16 at 100 s/s, 15 at 50 s/s, 180 at 10 s/s, and 150 at 1 s/s).

B. Parallel Digital - 1 - 16 bit channel at 200 s/s
1 - 8 bit channel at 50 s/s
1 - 32 bit channel at 10 s/s
31 - 8 bit channel at 10 s/s

C. Serial Digital - 1 - 40 bit channel at 50 s/s

In the LBR mode, the PCM equipment is capable of handling the following input signals:

A. High Level Analog (0-5 Vdc) - 100 channels at 1 s/s (these channels are not necessarily the same as the HBR 1 s/s channels).

B. Parallel Digital - 1 - 32 bit channel at 1 s/s
1 - 8 bit channel at 10 s/s
29 - 8 bit channel at 1 s/s

C. Serial Digital - 1 - 40 bit channel at 10 s/s

7.4.2 PCM Telemetry Formats

The HBR format, shown on Drawing 7.2, gives the bit stream word and prime frame location for each channel. The 128 word blocks make up a prime frame. A 200 s/s channel will appear in 4 word blocks, a 100 s/s channel will appear in 2 word blocks and a 50 s/s channel will appear in 1 word block in each prime frame. The 10 s/s channels will appear in every fifth prime frame. The 1 s/s channels will appear in only one prime frame. Prime frame locations are given in the word blocks by the following code:

- A - All prime frames
- B - Prime Frames 1, 6, 11, 16...46
- C - Prime Frames 2, 7, 12, 17...47
- D - Prime Frames 3, 8, 13, 18...48
- E - Prime Frames 4, 9, 14, 19...49
- F - Prime Frames 5, 10, 15, 20...50
- 1, 2, 3...50 - Prime Frames 1, 2, 3...50.

The LBR format gives the word location (1 through 200) of each channel appearing in the LBR bit stream.

7.4.3 Programer

The programer maintains primary control of all functioning units of the PCM equipment. It uses CTE or internal clock pulses to generate gating and control signals for sampling and processing data.

7.4.4 Analog Data

Each analog data input is connected to an analog gate. The analog gates are grouped in matrix combinations, basically arranged in such a manner that five channel inputs (columns) are provided per row with multiple rows used to form the

*

desired matrices. The five analog gates in each column utilize a common Sequencer Gate (SG). Drawing 7.2 shows the matrix combinations used for analog signals. A row command and a column command must both be present for an analog gate to transfer the data signal via the sequencer gate and high-speed gate to an analog coder.

The selected coder uses a successive approximation technique to code the analog 0 to 5 Vdc signal into an 8-bit binary coded word. This 8-bit word is fed to the digital multiplexer where it is transferred to the output shift register when the coder gate is interrogated.

7.4.5 Parallel Digital Data

Each parallel digital (or event) signal is connected to a gate in the digital multiplexer. When the digital multiplexer gate is interrogated, the output shift register will be loaded with a "1" if the input signal is greater than 3.5 Vdc or if the input is open circuited. The output shift register will remain a zero provided the input signal is less than 0.5 Vdc and the input impedance is less than 5k ohms.

7.4.6 PCM Telemetry Parameters

Tables 7-1 through 7-14 list the PCM telemetry parameters that will be available for real-time analysis. Onboard display and GSE parameters are not listed. Information on parameters not listed is available in the Apollo Baseline Master Measurements list and/or the Apollo Instrumentation Equipment List for Spacecraft 104.

*

7.4.6.1 Column definitions for tables 7-I through 7-XIV.-

A. Column 1 - Meas ID

The Measurement ID consists of seven characters:

Two letters follow by four numbers and one letter.

1. Module Code

The first letter designates the measurement location by module.

- A - ADAPTER
- B - BOOSTER
- C - COMMAND MODULE
- L - LAUNCH ESCAPE TOWER
- S - SERVICE MODULE

2. Functional Subsystem Code

The second letter denotes the subsystem wherein the measurement originates.

- A - STRUCTURES
- C - ELECTRICAL POWER
- D - MASTER EVENTS SEQUENCE CONTROLLER
- E - EARTH LANDING SEQUENCE CONTROLLER
- F - ENVIRONMENTAL CONTROL
- G - GUIDANCE & NAVIGATION
- H - STABILIZATION & CONTROL
- J - CREW EQUIPMENT
- K - FLIGHT TECHNOLOGY
- L - SCIENTIFIC EQUIPMENT
- P - SERVICE PROPULSION
- R - REACTION CONTROL
- S - L/V EMERGENCY DETECTION
- T - COMMUNICATIONS AND INSTRUMENTATION

3. Discrete Number

Characters three through six are discrete numbers listed sequentially within each subsystem.

*

B. Column 2 - Meas Description

The measurement description is a brief, definitive title given to each measurement. Standard abbreviations are used, where applicable.

C. Column 3 - TM

The telemetry column contains two characters. The first character indicates the type of signal measured as follows:

H - High level analog

E - Event (one bit)

D - Digital word (more than one bit)

S - Serial digital word (more than one bit)

The second character indicates the telemetry format as follows:

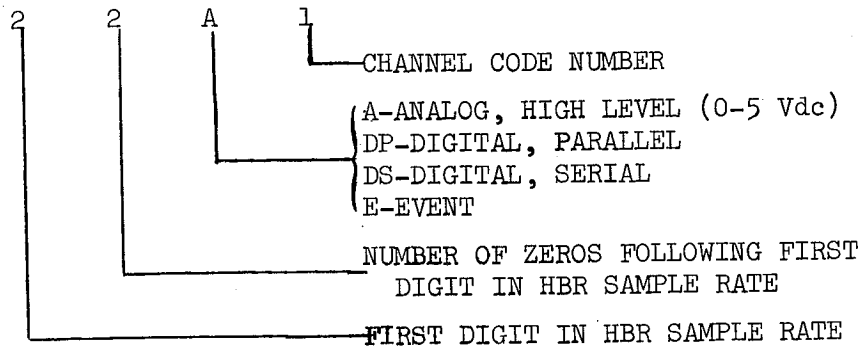
1 - HBR format only

2 - HBR and LBR formats

D. Column 4 - Chan Code

The channel code contains information giving the High Bit Rate (HBR) sample rate, the type of parameter measurement (analog, digital, etc.), and the channel code number associated with that type of measurement.

EXAMPLE:



*

E. Column 5 - Data Range

The data range column indicates the total PCM range of the parameter. For bilevel parameters a PCM "one" state will be listed under HIGH and a PCM "zero" state will be listed under LOW.

F. Column 6 - Inst Bus

The instrumentation bus column will indicate the power source for a parameter. Some measurements are sensed and/or signal conditioned within a particular system using that systems' power and will be indicated by EPS, LES, EDS, ECS, G&N, S&C, SPS, C&W, and C&I.

The instrumentation system distributes +28 Vdc power directly to certain sensors and signal conditioners. These instrumentation power buses are shown on Drawing 7.1 and are designated.

V_1 - CM ESS INST BUS PWR FROM RHEB PNL 276-CB1
V_2 - CM ESS INST BUS PWR FROM RHEB PNL 276-CB2
V_{3S} - SM ESS INST BUS PWR FROM RHEB PNL 276-CB3
V_{4S} - SM ESS INST BUS PWR FROM RHEB PNL 276-CB4

G. Column 7 - Sig Cond

The signal conditioner column uses the following code to indicate the type of SCE module that is used to condition the signal.

AA - dc Active Attenuator
DA - dc Differential Amplifier
DBA - dc Differential Bridge Amplifier
AC - ac to dc Converter

H. Column 8 - Pwr Rqmts

The PWR requirement column gives dc power required for signal conditioner and sensor unless otherwise indicated. The power may or may not include onboard display requirements depending on whether the display is driven directly from the sig cond or not.

I. Column 9 - O. B. Displ

The following acronyms and * indicate the type of onboard display used for parameters that appear both onboard and in the PCM bit stream.

* - Displayed on C&W System

M - Displayed on Meter

SM - Displayed on Selectable Meter

L - Displayed on Lamp Indicator

TB - Displayed on Talk Back (FLAG)

STB - Displayed on Selectable Talk Back (FLAG)

SMB - Displayed on Selectable Meter and Talk Back

J. Column 10 - Sig Dist

The following acronyms indicate common circuit characteristics of the PCM parameters being displayed to the crew.

CS - Common Signal Drives Display and PCM

SS - Separate Signal Drives Display and PCM

TSC - Common Sensor but PCM is Signal Conditioned

K. Column 11 - DWG CSMSH

This column will reference the CSMSH drawing for system information.

TABLE 7-I.- PCM TELEMETRY - STRUCTURES

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
CA1800T	SIDE HS BOND LOC 1 TEMP	H1	10A65	-260	+600	DEG F	V_2	--		--	--	--
CA1803T	SIDE HS BOND LOC 4 TEMP	H1	10A70	-260	+600	DEG F	V_2	--	120 MA	--	--	--
CA1806T	SIDE HS BOND LOC 7 TEMP	H1	10A74	-260	+600	DEG F	V_2	--	TOTAL	--	--	--
CA1809T	SIDE HS BOND LOC 10 TEMP	H1	10A79	-260	+600	DEG F	V_2	--		--	--	--
SA2377T	BAY 2 OX TK SURFACE TEMP	H1	10A142	-100	+200	DEG F	V_{3S}	--	56 MA	--	--	--
SA2378T	BAY 3 OX TK SURFACE TEMP	H1	10A137	-100	+200	DEG F	V_{4S}	--	56 MA	--	--	--
SA2379T	BAY 5 FU TK SURFACE TEMP	H1	10A139	-100	+200	DEG F	V_{3S}	--	56 MA	--	--	--
SA2380T	BAY 6 FU TK SURFACE TEMP	H1	10A140	-100	+200	DEG F	V_{4S}	--	56 MA	--	--	--
SA2400T	OX LINE ENTRY SUMP TK TEMP	H1	10A143	-100	+200	DEG F	V_{3S}	--	56 MA	--	--	--
SA2401T	FU LINE ENTRY SUMP TK TEMP	H1	10A145	-100	+200	DEG F	V_{4S}	--	56 MA	--	--	--

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TABLE 7-II.- PCM TELEMETRY - ELECTRICAL POWER SYSTEM

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
SC0030Q	H_2 TK 1 QTY	H2	10A141	0	100	PCT	EPS	--	4W AC	M	CS	5.2
SC0031Q	H_2 TK 2 QTY	H2	10A144	0	100	PCT	EPS	--	4W AC	M	CS	5.2
SC0032Q	O_2 TK 1 QTY	H2	10A147	0	100	PCT	EPS	--	4W AC	M	CS	5.2
SC0033Q	O_2 TK 2 QTY	H2	10A42	0	100	PCT	EPS	--	4W AC	M	CS	5.2
SC0037P	O_2 TK 1 PRESS	H2	10A150	50	1050	PSIA	V_{4S}	--	25 MA	SM*	CS	5.2
SC0038P	O_2 TK 2 PRESS	H2	10A66	50	1050	PSIA	V_{3S}	--	25 MA	M*	CS	5.2
SC0039P	H_2 TK 1 PRESS	H2	10A36	0	350	PSIA	V_{4S}	--	25 MA	M*	CS	5.2
SC0040P	H_2 TK 2 PRESS	H2	10A39	0	350	PSIA	V_{3S}	--	25 MA	M*	CS	5.2
SC0041T	O_2 TK 1 TEMP	H2	10A54	-325	+80	DEG F	EPS	--	SC0032	--	--	5.2
SC0042T	O_2 TK 2 TEMP	H2	10A57	-325	+80	DEG F	EPS	--	SC0033	--	--	5.2
SC0043T	H_2 TK 1 TEMP	H2	10A60	-425	-200	DEG F	EPS	--	SC0030	--	--	5.2
SC0044T	H_2 TK 2 TEMP	H2	10A63	-425	-200	DEG F	EPS	--	SC0031	--	--	5.2
CC0175T	INVERTER 1 TEMP	H1	10A86	+32	+248	DEG F	V_{SC}	DBA	--	L*	CS	3.3
CC0176T	INVERTER 2 TEMP	H1	10A88	+32	+248	DEG F	V_{SC}	DBA	--	L*	CS	3.3
CC0177T	INVERTER 3 TEMP	H1	10A89	+32	+248	DEG F	V_{SC}	DBA	--	L*	CS	3.3
CC0200V	AC BUS 1 ϕA VOLTS	H2	11A147	0	150	VAC	V_{SC}	AC	--	SM*	TSC	3.3
CC0203V	AC BUS 2 ϕA VOLTS	H2	11A56	0	150	VAC	V_{SC}	AC	--	SM*	TSC	3.3
CC0206V	MAIN BUS A VOLTS	H2	11A57	0	+45	VDC	V_{SC}	AA	--	SM*	TSC	3.2
CC0207V	MAIN BUS B VOLTS	H2	11A58	0	+45	VDC	V_{SC}	AA	--	SM*	TSC	3.2
CC0210V	BAT BUS A VOLTS	H2	11A91	0	+45	VDC	V_{SC}	AA	--	SM	TSC	3.2
CC0211V	BAT BUS B VOLTS	H2	11A93		+45	VDC	V_{SC}	AA	--	SM	TSC	3.2
CC0215C	BAT CHGR	H2	11A73	0	+5	AMPS	V_{SC}	DA	--	SM	TSC	3.2
CC0222C	BAT A CUR	H2	11A74	0	+100	AMPS	V_{SC}	DA	--	SM	TSC	3.2
CC0223C	BAT B CUR	H2	11A109	0	+100	AMPS	V_{SC}	DA	--	SM	TSC	3.2
CC0224C	BAT C CUR	H2	11A110	0	+100	AMPS	V_{SC}	DA	--	SM	TSC	3.2
CC0232V	BAT RELAY BUS VOLTS	H2	11A75	0	+45	VDC	V_{SC}	AA	--	SM	CS	3.2
SC2060P	FC 1 N_2 PRESS	H1	11A29	0	75	PSIA	V_{4S}	--		SM	CS	5.3
SC2061P	FC 2 N_2 PRESS	H1	11A30	0	75	PSIA	V_{3S}	--		SM	CS	5.3
SC2062P	FC 3 N_2 PRESS	H1	11A35	0	75	PSIA	V_{3S}	--		SM	CS	5.3

TABLE 7-II.- PCM TELEMETRY - ELECTRICAL POWER SYSTEM - CONTINUED

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
SC2066P	FC 1 O_2 PRESS	H1	11A67	0	75	PSIA	V_{4S}	--		SM	CS	5.3
SC2067P	FC 2 O_2 PRESS	H1	11A68	0	75	PSIA	V_{3S}	--		SM	CS	5.3
SC2068P	FC 3 O_2 PRESS	H1	11A69	0	75	PSIA	V_{3S}	--		SM	CS	5.3
SC2069P	FC 1 H_2 PRESS	H1	11A70	0	75	PSIA	V_{4S}	--		SM	CS	5.3
SC2070P	FC 2 H_2 PRESS	H1	11A71	0	75	PSIA	V_{3S}	--		SM	CS	5.3
SC2071P	FC 3 H_2 PRESS	H1	11A72	0	75	PSIA	V_{3S}	--		SM	CS	5.3
SC2081T	FC 1 COND EXH TEMP	H2	10A51	+145	+250	DEG F	V_{SC}	DBA	--	SM※	CS	5.3
SC2082T	FC 2 COND EXH TEMP	H2	10A123	+145	+250	DEG F	V_{SC}	DBA	--	SM※	CS	5.3
SC2083T	FC 3 COND EXH TEMP	H2	10A69	+145	+250	DEG F	V_{SC}	DBA	--	SM※	CS	5.3
SC2084T	FC 1 SKIN TEMP	H2	10A72	+80	+550	DEG F	V_{SC}	DBA	--	SM※	CS	5.3
SC2085T	FC 2 SKIN TEMP	H2	10A75	+80	+550	DEG F	V_{SC}	DBA	--	SM※	CS	5.3
SC2086T	FC 3 SKIN TEMP	H2	10A78	+80	+550	DEG F	V_{SC}	DBA	--	SM※	CS	5.3
SC2087T	FC 1 RAD OUT TEMP	H2	10A126	-50	+300	DEG F	V_{4S}	--	56 MA	SMB※	CS	5.3
SC2088T	FC 2 RAD OUT TEMP	H2	10A129	-50	+300	DEG F	V_{3S}	--	56 MA	SMB※	CS	5.3
SC2089T	FC 3 RAD OUT TEMP	H2	10A132	-50	+300	DEG F	V_{3S}	--	56 MA	SMB※	CS	5.3
SC2090T	FC 1 RAD IN TEMP	H1	10A130	-50	+300	DEG F	V_{4S}	--	56 MA	--	--	5.3
SC2091T	FC 2 RAD IN TEMP	H1	10A131	-50	+300	DEG F	V_{3S}	--	56 MA	--	--	5.3
SC2092T	FC 3 RAD IN TEMP	H1	10A67	-50	+300	DEG F	V_{3S}	--	56 MA	--	--	5.3
SC2113C	FC 1 CUR	H2	11A76	0	+100	AMPS	V_{SC}	DA	--	SM	TSC	5.3
SC2114C	FC 2 CUR	H2	11A84	0	+100	AMPS	V_{SC}	DA	--	SM	TSC	5.3
SC2115C	FC 3 CUR	H2	11A85	0	+100	AMPS	V_{SC}	DA	--	SM	TSC	5.3
SC2139R	FC 1 H_2 FLOW	H1	11A77	0	0.2	LB/HR	V_{4S}	--	56 MA	SM※	CS	5.3
SC2140R	FC 2 H_2 FLOW	H1	11A78	0	0.2	LB/HR	V_{3S}	--	56 MA	SM※	CS	5.3
SC2141R	FC 3 H_2 FLOW	H1	11A79	0	0.2	LB/HR	V_{3S}	--	56 MA	SM※	CS	5.3
SC2142R	FC 1 O_2 FLOW	H1	11A80	0	1.6	LB/HR	V_{4S}	--	56 MA	SM※	CS	5.3
SC2143R	FC 2 O_2 FLOW	H1	11A81	0	1.6	LB/HR	V_{3S}	--	56 MA	SM※	CS	5.3
SC2144R	FC 3 O_2 FLOW	H1	11A82	0	1.6	LB/HR	V_{3S}	--	56 MA	SM※	CS	5.3

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TABLE 7-II.- PCM TELEMETRY - ELECTRICAL POWER SYSTEM - CONCLUDED

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	DATA RANGE UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
SC2160X	FC 1 PH	E2	11E28-1	NORM	HIGH	EVENT	EPS	--		STB*	CS	5.3
SC2161X	FC 2 PH	E2	11E28-2	NORM	HIGH	EVENT	EPS	--		STB*	CS	5.3
SC2162X	FC 3 PH	E2	11E28-3	NORM	HIGH	EVENT	EPS	--		STB*	CS	5.3
CC2962C	LM HEATER CURRENT	H2	11A47	0	+10	AMPS	V_{SC}	DA		SM	CS	5.3

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TABLE 7-III.- PCM TELEMETRY - LAUNCH ESCAPE SYSTEM

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
CD0005V	PYRO BUS A VOLTS	H1	11A9	0	+40	VDC	SEQ	--	1 MA	--	--	2.2
CD0006V	PYRO BUS B VOLTS	H1	11A5	0	+40	VDC	SEQ	--	1 MA	--	--	2.2
CD0023X	CM-SM SEP RELAY A	E2	11E22-1		SEP	EVENT	SEQ	--	1 MA	--	--	2.4
CD0024X	CM-SM SEP RELAY B	E2	11E23-1		SEP	EVENT	SEQ	--	1 MA	--	--	2.4
CD0123X	SLA SEP RELAY A	E2	11E22-5		SEP	EVENT	SEQ	--	1 MA	--	--	2.4
CD0124X	SLA SEP RELAY B	E2	11E23-7		SEP	EVENT	SEQ	--	1 MA	--	--	2.4
CD0130X	CREW ABORT A	E2	11E13-3		ABORT	EVENT	SEQ	--	300 MA	--	--	2.3
CD0131X	CREW ABORT B	E2	11E13-6		ABORT	EVENT	SEQ	--	300 MA	--	--	2.3
CD0132X	EDS ABORT VOTE 1	E2	11E14-1	VOTE/OFF	ARM	EVENT	EDS	--	300 MA	--	--	2.3
CD0133X	EDS ABORT VOTE 2	E2	11E14-2	VOTE/OFF	ARM	EVENT	EDS	--	300 MA	--	--	2.3
CD0134X	EDS ABORT VOTE 3	E2	11E14-4	VOTE/OFF	ARM	EVENT	EDS	--	300 MA	--	--	2.3
CD0135X	EDS ABORT A	E2	11E13-7		ABORT	EVENT	EDS	--	2 MA	--	--	2.3
CD0136X	EDS ABORT B	E2	11E13-4		ABORT	EVENT	EDS	--	2 MA	--	--	2.3
CD0170X	SCS CHANNEL ENABLE RCS A	E2	11E22-3		ENABLE	EVENT	SEQ	--	1 MA	--	--	2.4
CD0171X	SCS CHANNEL ENABLE RCS B	E2	11E23-3		ENABLE	EVENT	SEQ	--	1 MA	--	--	2.4
CD0173X	CM RCS PRESS SIG A	E2	11E22-7		PRESS	EVENT	SEQ	--	1 MA	--	--	2.4
CD0174X	CM RCS PRESS SIG B	E2	11E23-5		PRESS	EVENT	SEQ	--	1 MA	--	--	2.4
CD0200V	LOGIC BUS A VOLTS	H1	11A8	0	+40	VDC	SEQ	--	1 MA	--	--	2.2
CD0201V	LOGIC BUS B VOLTS	H1	11A6	0	+40	VDC	SEQ	--	1 MA	--	--	2.2
CD0230X	FWD HS JET A	E2	11E24-1		JETT	EVENT	SEQ	--	1 MA	--	--	2.5
CD0231X	FWD HS JET B	E2	11E26-5		JETT	EVENT	SEQ	--	1 MA	--	--	2.5
CD1154X	CSM-LM LOCK RING SEP RELAY A	E2	11E15-6		SEP	EVENT	SEQ	--	1 MA	--	--	2.7
CD1155X	CSM-LM LOCK RING SEP RELAY B	E2	11E15-7		SEP	EVENT	SEQ	--	1 MA	--	--	2.7

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TABLE 7-IV.- PCM TELEMETRY - EARTH LANDING SEQUENCE CONTROLLER

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	DATA RANGE UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
CE0001X	DROGUE DEP. RELAY A	E2	11E29-1		DEPLOY	EVENT	V_2	--	1 MA	--	--	2.5
CE0002X	DROGUE DEP RELAY B	E2	11E30-6		DEPLOY	EVENT	V_2	--	1 MA	--	--	2.5
CE0003X	MAIN DEPLOY RELAY A	E2	11E29-8		DEPLOY	EVENT	V_2	--	1 MA	--	--	2.5
CE0004X	MAIN DEPLOY RELAY B	E2	11E30-3		DEPLOY	EVENT	V_2	--	1 MA	--	--	2.5
CE0321X	MAIN CHUTE DISC RELAY A	E2	11E29-5		DISC	EVENT	V_2	--	1 MA	--	--	2.5
CE0322X	MAIN CHUTE DISC RELAY B	E2	11E30-8		DISC	EVENT	V_2	--	1 MA	--	--	2.5

TABLE 7-V.- PCM TELEMETRY - ENVIRONMENTAL CONTROL SYSTEM

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
CF0001P	CABIN PRESS	H2	10A6	0	17	PSIA	ECS	--	25 MA	M	CS	4.2
CF0002T	CABIN TEMP	H2	10A84	+40	+125	DEG F	ECS	--	80 MA	M	CS	4.3
CF0003P	SUIT-CABIN DELTA PRESS	H1	11A37	-5	+5	IN H_2O	V_2	--	10 MA	M	CS	4.2
CF0005P	CO_2 PARTIAL PRESS	H2	10A3	0	30	MM HG	ECS	--	40 MA	M**	SS	4.2
CF0006P	SURGE TANK PRESS	H2	11A4	50	1050	PSIA	V_2	--	56 MA	SM	CS	4.2
CF0008T	SUIT AIR HX OUT TEMP	H2	10A45	+20	+95	DEG F	ECS	--	356 MA	M	CS	4.2
CF0009Q	WASTE H_2O QTY	H2	10A9	0	100	PCT	ECS	--	40 MA	SM	CS	4.5
CF0010Q	POTABLE H_2O QTY	H2	10A81	0	100	PCT	ECS	--	40 MA	SM	CS	4.5
CF0012P	SUIT MANF ABS PRESS	H2	11A1	0	17	PSIA	ECS	--	25 MA	M	CS	4.2
CF0015P	SUIT COMP DELTA P	H2	11A2	0	1	PSID	ECS	--	40 MA	M**	CS	4.2
CF0016P	GLY PUMP OUT PRESS	H2	11A3	0	60	PSIG	ECS	--	25 MA	SM	CS	4.3
CF0017T	GLY EVAP OUT STEAM TEMP	H1	10A133	+20	+95	DEG F	ECS	--	CF0008T	--	--	4.3
CF0018T	GLY EVAP OUT TEMP	H2	10A12	+25	+75	DEG F	ECS	--	CF0008T	SM	CS	4.3
CF0019Q	GLY ACCUM QTY	H2	11A13	0	100	PCT	ECS	--	25 MA	SM	CS	4.3
CF0020T	ECS RAD OUT TEMP	H2	10A15	-50	+100	DEG F	ECS	--	CF0008T	M**	CS	4.3
CF0034P	GLY EVAP BACK PRESS	H1	10A4	+0.05	+0.25	PSIA	ECS	--	40 MA	SM	CS	4.3
CF0035R	ECS O_2 FLOW O_2 SUPPLY MANF	H1	11A14	0.2	1.0	LB/HR	ECS	--	120 MA	M**	CS	4.2
CF0036P	O_2 SUPPLY MANF PRESS	H2	11A55	0	150	PSIG	ECS	--	25 MA	--	--	4.2
CF0070P	SEC GLY PUMP OUT PRESS	H2	11A157	0	60	PSIG	ECS	--	25 MA	SM	CS	4.4
CF0071T	SEC EVAP OUT LIQ TEMP	H2	11A118	+25	+75	DEG F	ECS	--	CF0008T	SM	CS	4.4
CF0072Q	SEC GLY ACCUM QUANTITY	H2	11A129	0	100	PCT	ECS	--	25 MA	SM	CS	4.4
CF0073P	SEC EVAP OUT STEAM PRESS	H1	10A8	0.05	0.25	PSIA	ECS	--	40 MA	SM	CS	4.4
CF0120P	H_2O TANK - GLY RES PRESS	H1	10A101	0	50	PSIA	V_2	--	10 MA	--	--	4.2
CF0157R	PRI GLYCOL FLOW RATE	H1	11A87	+150	+300	LB/HR	V_2	--	10 MA	--	--	4.3
CF0181T	PRI EVAP INLET TEMP	H1	10A100	+35	+100	DEG F	V_2	--	56 MA	--	--	4.3
SF0260T	PRI RAD IN TEMP	H2	10A48	+55	+120	DEG F	ECS	--	25 MA	SM	CS	4.3
SF0262T	SEC RAD IN TEMP	H2	10A87	+55	+120	DEG F	ECS	--	25 MA	SM	CS	4.4
SF0263T	SEC RAD OUT TEMP	H2	10A90	+30	+70	DEG F	ECS	--	25 MA	M	CS	4.4

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TABLE 7-V.- PCM TELEMETRY - ENVIRONMENTAL CONTROL SYSTEM - CONCLUDED

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	DATA RANGE UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH	
SF0266X	RAD FLOW CONT SYS 1 OR 2	E2	11E4-8	SYS 1	SYS 2	EVENT	V_{SC}	AA	--	TB	TSC	4.3	
CF0460T	H_2O DUMP TEMP	H2	10A114	0	+100	DEG F	V_2	--	56 MA	--	--	4.5	P-1
CF0461T	URINE DUMP NOZZLE TEMP	H2	10A135	0	+100	DEG F	V_1	--	56 MA	--	--	4.5	

TABLE 7-VI.- PCM TELEMETRY - GUIDANCE AND NAVIGATION SYSTEM

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
CG0001V	CPTR DIG DATA - 40 BITS	S2	51DS1			--	--	--	--	--	--	8.1
CG1040V	PIPA + 120 VDC	H1	10A83	+85	+135	VDC	G&N	--	--	--	--	8.1, 8.5
CG1110V	TM BIAS 2.5 VDC	H2	10A138	0	5	VDC	G&N	--	--	--	--	8.1, 8.4
CG1201V	IMU 28 VAC 800HZ	H1	10A91	0	31.1	VRMS	G&N	--	--	--	--	8.1, 8.4
CG1331V	3.2 KHZ 28V SUPPLY	H1	10A85	0	31.1	VRMS	G&N	--	--	--	--	8.1 8.5
CG1513X	IMU HTR +28 VDC	E2	11E15-2	OFF	STBY	EVENT	G&N	--	--	--	--	8.1 8.5
CG1523X	CMC OPERATE +28 VDC	E2	11E15-3	OFF	OPR	EVENT	G&N	--	--	--	--	8.1, 8.4
CG1533X	OPTX OPERATE 28 VAC	E2	11E15-4	OFF	OPR	EVENT	G&N	--	--	--	--	8.1, 8.4
CG2112V	IG 1X RSVR OUT SIN	H1	11A54	-50/+230	+50/+130	DEG	G&N	--	--	--	--	8.1, 8.5
CG2113V	IG 1X RSVR OUT COS	H1	11A59	+130/+230	+50/+310	DEG	G&N	--	--	--	--	8.1, 8.5
CG2117V	IGA SERVO ERR IN PHASE	H1	12A2	-2.5	+2.5	MRAD	G&N	--	--	--	--	8.1, 8.5
CG2142V	MG 1X RSVR OUT SIN	H1	11A60	-50/+230	+50/+130	DEG	G&N	--	--	--	--	8.1, 8.5
CG2143V	MG 1X RSVR OUT COS	H1	11A61	+130/+230	+50/+310	DEG	G&N	--	--	--	--	8.1, 8.5
CG2147V	MGA SERVO ERR IN PHASE	H1	12A1	-2.5	+2.5	MRAD	G&N	--	--	--	--	8.1, 8.5
CG2172V	OG 1X RSVR OUT SIN	H1	11A62	-50/+230	+50/+130	DEG	G&N	--	--	--	--	8.1, 8.5
CG2173V	OG 1X RSVR OUT COS	H1	11A63	+130/+230	+50/+310	DEG	G&N	--	--	--	--	8.1, 8.5
CG2177V	OGA SERVO ERR IN PHASE	H1	12A3	-2.5	+2.5	MRAD	G&N	--	--	--	--	8.1, 8.5
CG2300T	PIPA TEMP	H2	10A96	+120	+140	DEG F	G&N	--	--	--	--	8.1, 8.5
CG3721V	SHAFT CDU DAC OUT	H1	11A52	-10	+10	VRMS	G&N	--	--	--	--	8.1, 8.6, 8.9
CG3722V	TRUNNION CDU OUT	H1	11A53	-10	+10	VRMS	G&N	--	--	--	--	8.1, 8.6, 8.9
CG5040X	CMC WARNING	E2	11E19-1		WARN	EVENT	G&N	--	--	L*	--	8.1

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TABLE 7-VII.- PCM TELEMETRY - STABILIZATION AND CONTROL SYSTEM

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
CH3500H	PITCH ATT ERR	H1	51A5	-5/5/15	+5/5/15	DEG	S&C	--	--	M	TSC	8.3,8.8
CH3501H	YAW ATT ERR	H1	51A6	-5/5/15	+5/5/15	DEG	S&C	--	--	M	TSC	8.3,8.8
CH3502H	ROLL ATT ERR	H1	12A4	-5/5/50	+5/5/50	DEG	S&C	--	--	M	TSC	8.3,8.8
CH3503R	SCS PITCH BODY RATE	H1	12A5	-1/5/10	+1/5/10	DEG/S	S&C	--	--	M	TSC	8.3,8.8
CH3504R	SCS YAW BODY RATE	H1	12A6	-1/5/10	+1/5/10	DEG/S	S&C	--	--	M	TSC	8.3,8.8
CH3505R	SCS ROLL BODY RATE	H1	12A7	-1/5/50	+1/5/50	DEG/S	S&C	--	--	M	TSC	8.3,8.8
CH3517H	PITCH GMBL POS 1 OR 2	H1	12A8	-5.0	+5.0	DEG	S&C	--	--	SM	TSC	8.3,8.9
CH3518H	YAW GMBL POS 1 OR 2	H1	12A10	-5.0	+5.0	DEG	S&C	--	--	SM	TSC	8.3,8.9
CH3546X	+PITCH/+X ENG	E1	22E1-1	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.10
CH3547X	-PITCH/+X ENG	E1	22E2-2	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.10
CH3548X	+PITCH/-X ENG	E1	22E3-3	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.10
CH3549X	-PITCH/-X ENG	E1	22E4-4	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.10
CH3550X	+YAW/+X ENG	E1	22E5-5	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.10
CH3551X	-YAW/+X ENG	E1	22E6-6	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.10
CH3552X	+YAW/-X ENG	E1	22E7-7	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.10
CH3553X	-YAW/-X ENG	E1	22E8-8	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.10
CH3554X	+ROLL/+Z ENG	E1	22E9-1	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.10
CH3555X	-ROLL/+Z ENG	E1	22E13-5	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.10
CH3556X	+ROLL/-Z ENG	E1	22E14-6	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.10
CH3557X	-ROLL/-Z ENG	E1	22E10-2	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.10
CH3558X	+ROLL/+Y ENG	E1	22E15-7	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.10
CH3559X	-ROLL/+Y ENG	E1	22E11-3	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.10
CH3560X	+ROLL/-Y ENG	E1	22E12-4	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.10
CH3561X	-ROLL/-Y ENG	E1	22E16-8	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.10
CH3574X	TRANS CNTL +X CMD	E2	11E22-4	OFF	ON	EVENT	S&C	--	--	--	--	8.10
CH3575X	TRANS CNTL -X CMD	E2	11E22-6	OFF	ON	EVENT	S&C	--	--	--	--	8.10
CH3576X	TRANS CNTL +Y CMD	E2	11E22-8	OFF	ON	EVENT	S&C	--	--	--	--	8.10
CH3577X	TRANS CNTL -Y CMD	E2	11E23-6	OFF	ON	EVENT	S&C	--	--	--	--	8.10

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TABLE 7-VII.- PCM TELEMETRY - STABILIZATION AND CONTROL SYSTEM - CONTINUED

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH	
CH3578X	TRANS CNTL +Z CMD	E2	11E23-8	OFF	ON	EVENT	S&C	--	--	--	--	8.10	P-1
CH3579X	TRANS CNTL -Z CMD	E2	11E24-2	OFF	ON	EVENT	S&C	--	--	--	--	8.10	
CH3582V	SCS TVC PITCH AUTO CMD	H1	12A15	-10	+10	VDC	S&C	--	--	--	--	8.9	
CH3583V	SCS TVC YAW AUTO CMD	H1	12A13	-10	+10	VDC	S&C	--	--	--	--	8.9	
CH3585H	MTVC PITCH CMD	H1	51A11	-11.5	+11.5	DEG	S&C	--	--	--	--	8.9	
CH3586H	MTVC YAW CMD	H1	51A12	-11.5	+11.5	DEG	S&C	--	--	--	--	8.9	
CH3587H	ROT ROLL CMD	H1	51A13	-11.5	+11.5	DEG	S&C	--	--	--	--	8.9	
CH3588X	ATT DEADBAND MIN	E2	11E8-2	MAX	MIN	EVENT	S&C	--	--	--	--	8.3,8.9A	
CH3590X	HI RATE LIMIT	E2	11E8-4	LOW	HIGH	EVENT	S&C	--	--	--	--	8.3,8.9A	
CH3592X	FDAI ERR 5 RATE 5	E2	11E8-5	OFF	ON	EVENT	S&C	--	--	--	--	8.3	
CH3593X	FDAI SCALE ERR 50/15	E2	11E8-6	OFF	ON	EVENT	S&C	--	--	--	--	8.3	
CH3600X	ΔV CG LM/CSM	E2	11E9-3	CSM	LM/CSM	EVENT	S&C	--	--	--	--	8.9A	
CH3601X	DIRECT RCS NO. 1	E2	11E24-3	OFF	ENABLE	EVENT	S&C	--	--	--	--	8.7	P-1
CH3602X	DIRECT RCS NO. 2	E2	11E24-4	OFF	ENABLE	EVENT	S&C	--	--	--	--	8.7	
CH3604X	SPS SOL DRIVER 1	E2	11E4-4	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.9	
CH3605X	SPS SOL DRIVER 2	E2	11E9-4	FIRE/OFF	ARM	EVENT	S&C	--	--	--	--	8.3,8.9	
CH3606X	LIMIT CYCLE SWITCH	E2	11E25-1	ON	OFF	EVENT	S&C	--	--	--	--	8.3,8.9A	
CH3607X	S/C CNTL SCS	E2	11E9-5	CMC	SCS	EVENT	S&C	--	--	--	--	8.3,8.9A, 8.9	
CH3609X	MANUAL ATT ROLL ACCEL CMD	E2	11E25-7	OFF	ON	EVENT	S&C	--	--	--	--	8.9A	P-1
CH3610X	MANUAL ATT ROLL MIN IMP CMD	E2	11E25-8	OFF	ON	EVENT	S&C	--	--	--	--	8.9A	
CH3612X	MANUAL ATT PITCH ACCEL CMD	E2	11E25-3	OFF	ON	EVENT	S&C	--	--	--	--	8.9A	
CH3613X	MANUAL ATT PITCH MIN IMP CMD	E2	11E25-4	OFF	ON	EVENT	S&C	--	--	--	--	8.9A	
CH3615X	MANUAL ATT YAW ACCEL CMD	E2	11E25-5	OFF	ON	EVENT	S&C	--	--	--	--	8.9A	
CH3616X	MANUAL ATT YAW MIN IMP CMD	E2	11E25-6	OFF	ON	EVENT	S&C	--	--	--	--	8.9A	
CH3623X	GYRO 1 COMB SMRD	E2	11E8-7	LOW	NORM	EVENT	S&C	--	--	--	--	8.2,8.9	
CH3624X	GYRO 2 COMB SMRD	E2	11E8-8	LOW	NORM	EVENT	S&C	--	--	--	--	8.2,8.9	
CH3635X	BMAG MODE SW-ROLL ATT 1 RT 2	E1	11E33-1	OFF	ON	EVENT	VSC	AA	--	--	--	8.3,8.9A	
CH3636X	BMAG MODE SW-ROLL RATE 2	E1	11E33-2	OFF	ON	EVENT	VSC	AA	--	--	--	8.3,8.9A	

TABLE 7-VII.- PCM TELEMETRY - STABILIZATION AND CONTROL SYSTEM - CONCLUDED

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	DATA RANGE UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
CH3638X	BMAG MODE SW-PITCH ATT 1 RT 2	E1	11E33-3	OFF	ON	EVENT	VSC	AA	--	--	--	8.3,8.9A
CH3639X	BMAG MODE SW-PITCH RATE 2	E1	11E33-4	OFF	ON	EVENT	VSC	AA	--	--	--	8.3,8.9A
CH3641X	BMAG MODE SW-YAW ATT 1 RT 2	E1	11E33-5	OFF	ON	EVENT	VSC	AA	--	--	--	8.3,8.9A
CH3642X	BMAG MODE SW-YAW RATE 2	E1	11E33-6	OFF	ON	EVENT	VSC	AA	--	--	--	8.3,8.9A
CH3666C	PITCH DIFF CLUTCH CURRENT	H1	22A4	-0.807	+0.807	AMP	S&C	--	--	--	--	8.9
CH3667C	YAW DIFF CLUTCH CURRENT	H1	12A16	-0.807	+0.807	AMP	S&C	--	--	--	--	8.9

TABLE 7-VIII.- PCM TELEMETRY - LIFE SYSTEM

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	DATA RANGE UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
CJ0060J	ASTRO 1 EKG AXIS 1	H1	22A3	0.1	5	MV	V_2	--	150 MA	--	--	
CJ0061J	ASTRO 2 EKG AXIS 1	H1	22A1	0.1	5	MV	V_2	--	150 MA	--	--	
CJ0062J	ASTRO 3 EKG AXIS 1	H1	22A2	0.1	5	MV	V_2	--	150 MA	--	--	
CJ0200R	ASTRO 1 RESPIR	H1	51A7	-5	+5	OHMS	V_2	--	CJ0060	--	--	
CJ0201R	ASTRO 2 RESPIR	H1	51A8	-5	+5	OHMS	V_2	--	CJ0061	--	--	
CJ0202R	ASTRO 3 RESPIR	H1	51A9	-5	+5	OHMS	V_2	--	CJ0062	--	--	

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TABLE 7-IX.- PCM TELEMETRY - FLIGHT TECHNOLOGY

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
CK0026A	CM X-AXIS ACCEL	H1	12A9	-2	+10	G	V_2	--	50 MA	--	--	
CK0027A	CM Y-AXIS ACCEL	H1	12A11	-2	+2	G	V_2	--	45 MA	--	--	
CK0028A	CM Z-AXIS ACCEL	H1	12A12	-2	+2	G	V_2	--	45 MA	--	--	
CK1051K	DOSIMETER 1 RADIATION	H1	11A169	0	1K	RAD/H	V_2	--		--	--	
CK1052K	DOSIMETER 2 RADIATION	H1	11A16	0	1K	RAD/H	V_2	--		--	--	
CK1053R	DOSIMETER RATE	H1	10A149	0	5	VDC	V_2	--		--	--	

TABLE 7-X.- PCM TELEMETRY - SCIENTIFIC EQUIPMENT

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	HIGH	UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
SL1001U	SCI EXP NO. 1	H2	10A108									
SL1002U	SCI EXP NO. 2	H2	10A111									
SL1003U	SCI EXP NO. 3	H1	10A104									
SL1004U	SCI EXP NO. 4	H1	10A106									
SL1005U	SCI EXP NO. 5	H1	10A107									
SL1006U	SCI EXP NO. 6	H1	10A109									
SL1007U	SCI EXP NO. 7	H1	10A110									
SL1008U	SCI EXP NO. 8	H1	10A112									
SL1009U	SCI EXP NO. 9	H1	10A113									
SL1010U	SCI EXP NO. 10	H1	10A115									
SL1011U	SCI EXP NO. 11	H1	10A116									
SL1012U	SCI EXP NO. 12	H1	10A118									
SL1013U	SCI EXP NO. 13	H1	10A119									
SL1014U	SCI EXP NO. 14	H1	10A121									
SL1015U	SCI EXP NO. 15	H1	10A122									
SL1016U	SCI EXP NO. 16	D2	11D16									
SL1017U	SCI EXP NO. 17	D2	11D3									
SL1018U	SCI EXP NO. 18	D2	11D5									
SL1019U	SCI EXP NO. 19	D2	11D6									
SL1020U	SCI EXP NO. 20	D2	11D7									
SL1021U	SCI EXP NO. 21	D2	11D10									
SL1022U	SCI EXP NO. 22	D2	11D11									
SL1023U	SCI EXP NO. 23	D2	11D12									
SL1024U	SCI EXP NO. 24	D2	11D17									
SL1025U	SCI EXP NO. 25	D2	11D18									

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TABLE 7-XI.- PCM TELEMETRY - SERVICE PROPULSION SYSTEM

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	DATA RANGE UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
SP0001P	HE TK PRESS	H2	11A10	0	5K	PSIA	V_{3S}	--	56 MA	--	--	9.1
SP0002T	HE TK PRESS	H1	10A16	-100	+200	DEG F	V_{4S}	--	56 MA	--	--	9.1
SP0003P	OX TK PRESS	H2	11A11	0	250	PSIA	V_{3S}	--	56 MA	M*	CS	9.1
SP0006P	FU TK PRESS	H2	11A12	0	250	PSIA	V_{4S}	--	56 MA	M*	CS	9.1
SP0022H	FU/OX VLV 1 POS	H1	11A31	0	90	DEG	V_{3S}	--	--	--	--	9.1
SP0023H	FU/OX VLV 2 POS	H1	11A32	0	90	DEG	V_{4S}	--	--	--	--	9.1
SP0024H	FU/OX VLV 3 POS	H1	11A33	0	90	DEG	V_{3S}	--	--	--	--	9.1
SP0025H	FU/OX VLV 4 POS	H1	11A34	0	90	DEG	V_{4S}	--	--	--	--	9.1
SP0045T	SPS VLV BODY TEMP	H1	10A37	0	+200	DEG F	V_{4S}	--	56 MA	--	--	9.1
SP0048T	SPS FU FEED LINE TEMP	H2	10A117	0	+200	DEG F	V_{3S}	--	56 MA	M	CS	9.1
SP0049T	SPS OX FEED LINE TEMP	H2	10A120	0	+200	DEG F	V_{4S}	--	56 MA	SM	CS	9.1
SP0054T	OX LINE 1 TEMP	H1	10A44	0	+200	DEG F	V_{3S}	--	56 MA	--	--	9.1
SP0057T	FU LINE 1 TEMP	H1	10A59	0	+200	DEG F	V_{4S}	--	56 MA	--	--	9.1
SP0061T	SPS INJECTOR FLANGE TEMP 1	H1	10A47	0	+600	DEG F	V_{SC}	DBA	--	L*	CS	9.1
SP0062T	SPS INJECTOR FLANGE TEMP 2	H1	10A49	0	+600	DEG F	V_{SC}	DBA	--	L*	CS	9.1
SP0600P	SPS VLV ACT PRESS PRI	H1	10A10	0	5K	PSIA	V_{3S}	--	56 MA	SM	CS	9.1
SP0601P	SPS VLV ACT PRESS SEC	H1	10A11	0	5K	PSIA	V_{4S}	--	56 MA	SM	CS	9.1
SP0655Q	OX TK 1 QTY -TOTAL AUX	H1	10A26	0	50	PCT	SPS	--	--	--	--	9.2
SP0656Q	OX TK 2 QTY	H1	10A28	0	60	PCT	SPS	--	--	--	--	9.2
SP0657Q	FU TK 1 QTY-TOTAL AUX	H1	10A29	0	50	PCT	SPS	--	--	--	--	9.2
SP0658Q	FU TK 2 QTY	H1	10A31	0	60	PCT	SPS	--	--	--	--	9.2
SP0661P	ENG CHAMBER PRESS	H1	12A14	0	150	PSIA	V_{3S}	--	56 MA	SM	CS	9.1
SP0930P	FUEL SM/ENG INTERFACE P	H1	11A152	0	300	PSIA	V_{3S}	--	56 MA	--	--	9.1
SP0931P	OX SM/ENG INTERFACE P	H1	11A161	0	300	PSIA	V_{4S}	--	56 MA	--	--	9.1

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TABLE 7-XII.- PCM TELEMETRY - REACTION CONTROL SYSTEM

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	DATA RANGE UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
CR0001P	CM HE TK A PRESS	H2	10A18	0	5K	PSIA	V_1	--	56 MA	SM	CS	10.2
CR0002P	CM HE TK B PRESS	H2	10A21	0	5K	PSIA	V_2	--	56 MA	SM	CS	10.2
CR0003T	CM HE TK A TEMP	H2	11A155	0	300	DEG F	V_1	--	56 MA	SM	CS	10.2
CR0004T	CM HE TK B TEMP	H2	11A156	0	300	DEG F	V_2	--	56 MA	SM	CS	10.2
CR0035P	CM HE MANIF 1 PRESS	H2	11A21	0	400	PSIA	V_1	--	56 MA	L*	CS	10.2
CR0036P	CM HE MANIF 2 PRESS	H2	11A22	0	400	PSIA	V_2	--	56 MA	L*	CS	10.2
SR5001P	SM HE TK A PRESS	H2	10A24	0	5K	PSIA	V_{3S}	--	56 MA	SM	CS	10.1
SR5002P	SM HE TK B PRESS	H2	10A27	0	5K	PSIA	V_{4S}	--	56 MA	SM	CS	10.1
SR5003P	SM HE TK C PRESS	H2	10A30	0	5K	PSIA	V_{3S}	--	56 MA	SM	CS	10.1
SR5004P	SM HE TK D PRESS	H2	10A33	0	5K	PSIA	V_{4S}	--	56 MA	SM	CS	10.1
SR5013T	SM HE TK A TEMP	H2	11A163	0	+100	DEG F	V_{3S}	--	56 MA	SM	CS	10.1
SR5014T	SM HE TK B TEMP	H2	11A164	0	+100	DEG F	V_{4S}	--	56 MA	SM	CS	10.1
SR5015T	SM HE TK C TEMP	H2	11A165	0	+100	DEG F	V_{3S}	--	56 MA	SM	CS	10.1
SR5016T	SM HE TK D TEMP	H2	11A166	0	+100	DEG F	V_{4S}	--	56 MA	SM	CS	10.1
SR5025Q	SM HE PRESS/TEMP RATIO A	H2	10A93	0	100	PCT	V_{3S}	--	56 MA	SM	CS	10.1
SR5026Q	SM HE PRESS/TEMP RATIO B	H2	10A99	0	100	PCT	V_{4S}	--	56 MA	SM	CS	10.1
SR5027Q	SM HE PRESS/TEMP RATIO C	H2	10A102	0	100	PCT	V_{3S}	--	56 MA	SM	CS	10.1
SR5028Q	SM HE PRESS/TEMP RATIO D	H2	10A105	0	100	PCT	V_{4S}	--	56 MA	SM	CS	10.1
SR5065T	SM ENG PACKAGE A TEMP	H1	10A136	0	+300	DEG F	V_{3S}	--	56 MA	SM*	CS	10.1
SR5066T	SM ENG PACKAGE B TEMP	H1	10A17	0	+300	DEG F	V_{4S}	--	56 MA	SM*	CS	10.1
SR5067T	SM ENG PACKAGE C TEMP	H1	10A19	0	+300	DEG F	V_{3S}	--	56 MA	SM*	CS	10.1
SR5068T	SM ENG PACKAGE D TEMP	H1	10A20	0	+300	DEG F	V_{4S}	--	56 MA	SM*	CS	10.1
SR5729P	SM HE MANF A PRESS	H2	11A39	0	400	PSIA	V_{3S}	--	56 MA	--	--	10.1
SR5733P	SM OX MANF A PRESS	H1	11A23	0	300	PSIA	V_{3S}	--	56 MA	--	--	10.1
SR5737P	SM FU MANF A PRESS	H2	11A92	0	400	PSIA	V_{3S}	--	56 MA	SM*	CS	10.1

FEC/TSG - 94 (NOV. 67)

TABLE 7-XII.- PCM TELEMETRY - REACTION CONTROL SYSTEM - CONCLUDED

MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	DATA RANGE UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
SR5776P	SM HE MANF B PRESS	H2	11A40	0	400	PSIA	V_{4S}	--	56 MA	--	--	10.1
SR5780P	SM OX MANF B PRESS	H1	11A24	0	300	PSIA	V_{4S}	--	56 MA	--	--	10.1
SR5784P	SM FU MANF B PRESS	H2	11A94	0	400	PSIA	V_{4S}	--	56 MA	SM※	CS	10.1
SR5817P	SM HE MANF C PRESS	H2	11A46	0	400	PSIA	V_{3S}	--	56 MA	--	--	10.1
SR5820P	SM OX MANF C PRESS	H1	11A27	0	300	PSIA	V_{3S}	--	56 MA	--	--	10.1
SR5821P	SM OX MANF D PRESS	H1	11A28	0	300	PSIA	V_{4S}	--	56 MA	--	--	10.1
SR5822P	SM FU MANF C PRESS	H2	11A111	0	400	PSIA	V_{3S}	--	56 MA	SM※	CS	10.1
SR5823P	SM FU MANF D PRESS	H2	11A112	0	400	PSIA	V_{4S}	--	56 MA	SM※	CS	10.1
SR5830P	SM HE MANF D PRESS	H2	11A130	0	400	PSIA	V_{4S}	--	56 MA	--	--	10.1

FEC/TSG - 94 (NOV. 67)

TABLE 7-XIII.- PCM TELEMETRY - CREW SAFETY SYSTEM

CSM
S/C

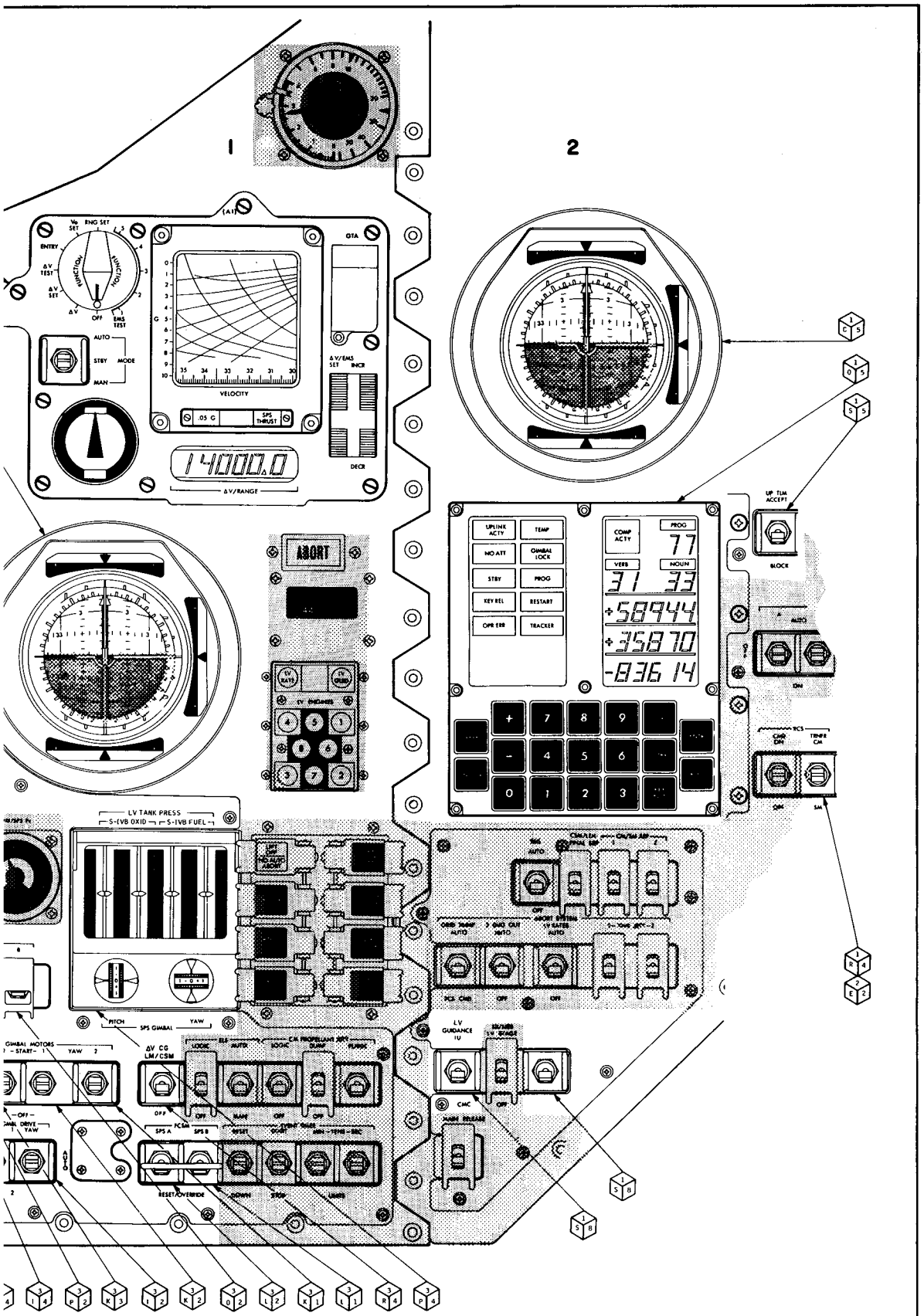
MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	DATA RANGE UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
BS0080X	SM EDS ABORT REQUEST A	E2	11E4-5	NORM	ABORT	EVENT	V_{SC}	AA	--	L	TSC	2.3,6.6
BS0081X	SM EDS ABORT REQUEST B	E2	11E4-3	NORM	ABORT	EVENT	V_{SC}	AA	--	L	TSC	2.3,6.6
CS0150X	MASTER CAUTION WARNING ON	E2	11E4-6	WARN/OFF	NORM	EVENT	V_{SC}	AA	--	L*	TSC	7.3
LS0200H	ANGLE OF ATTACK	H1	11A51	0	+5	VDC	EDS	--	--	SM	CS	
CS0220T	DOCKING PROBE TEMP	H1	10A22	-100	+300	DEG F	V2	--	56 MA	--	--	

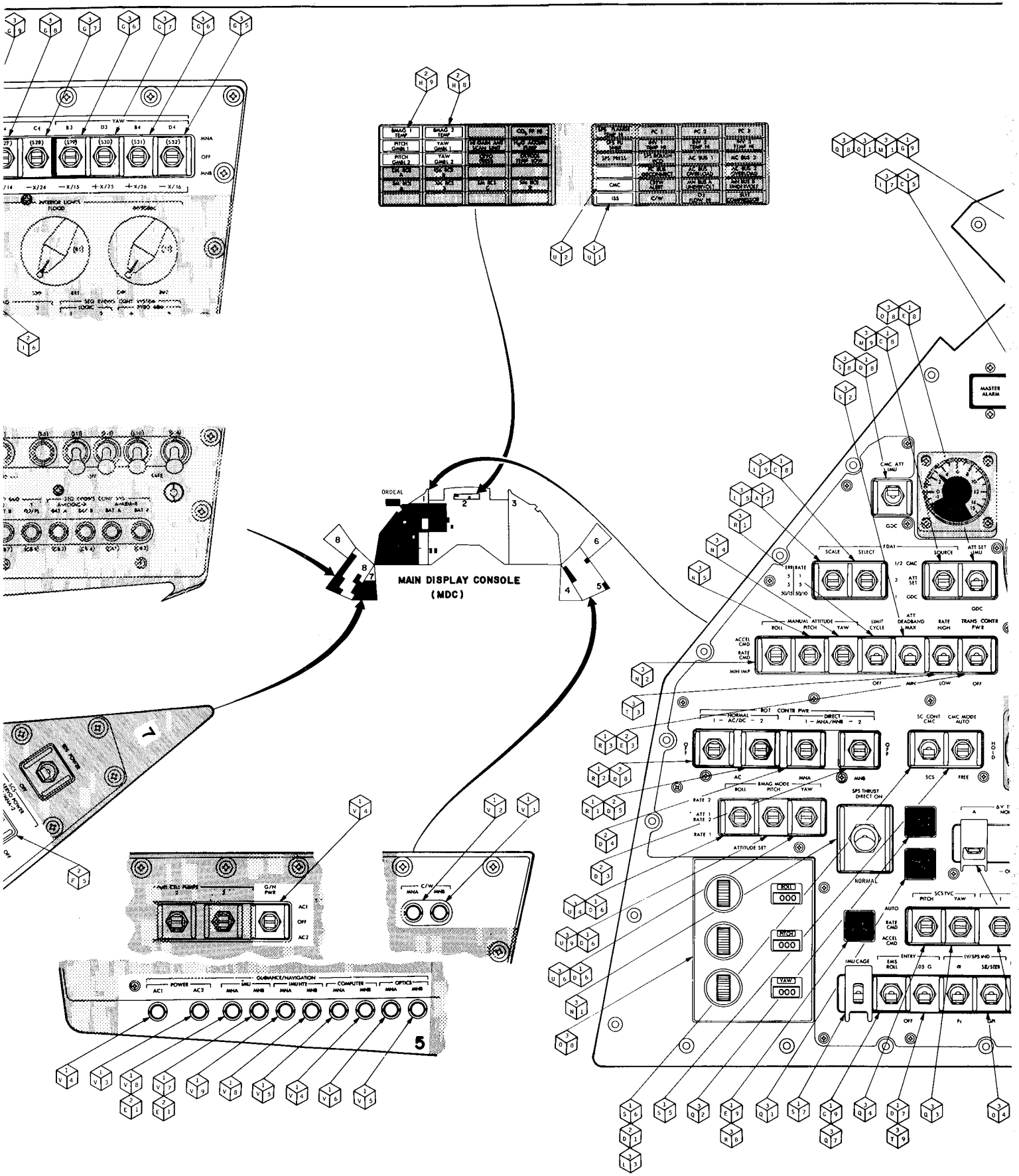
FEC/TSG - 94 (NOV. 67)

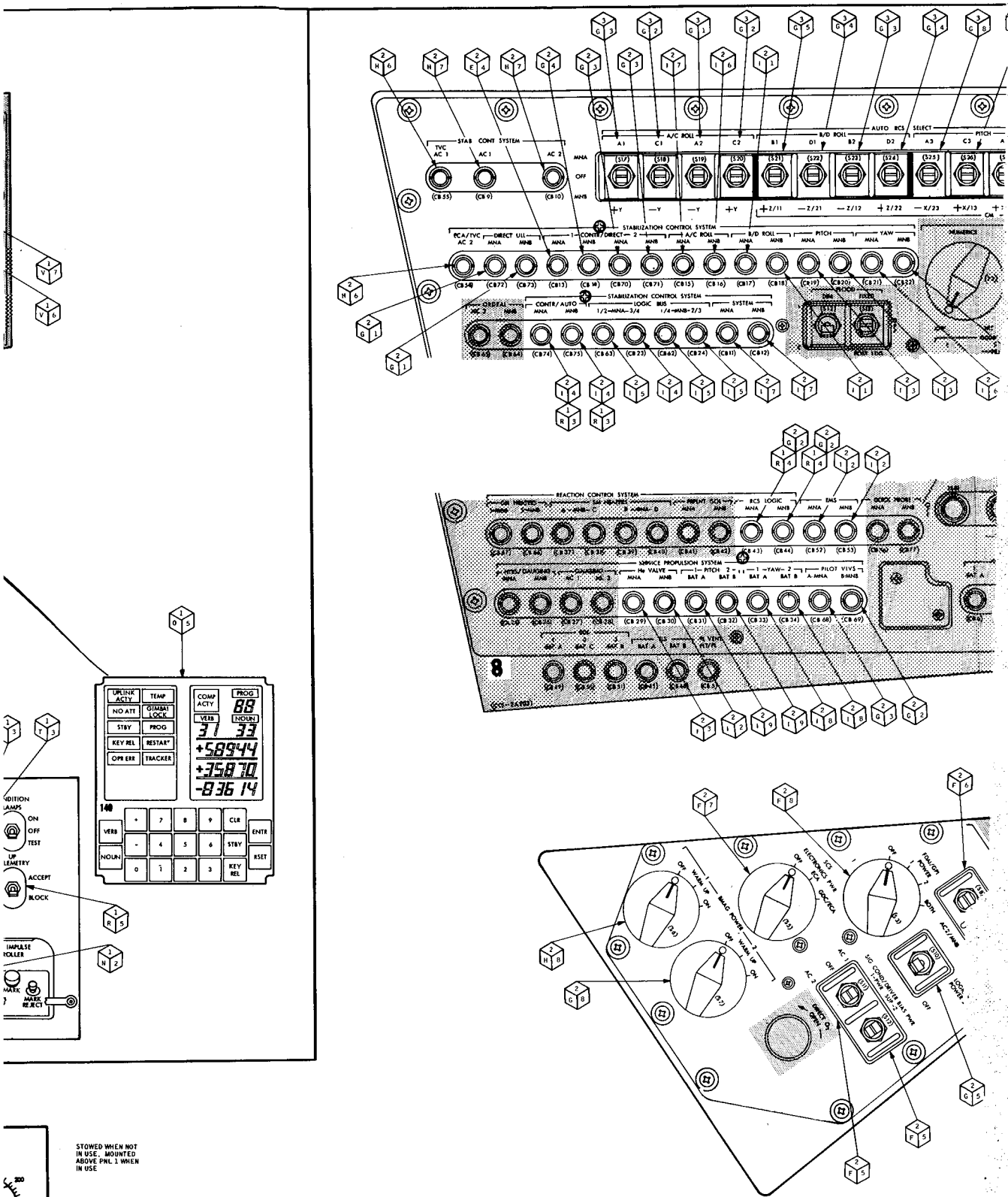
TABLE 7-XIV.- PCM TELEMETRY - COMMUNICATION AND INSTRUMENTATION

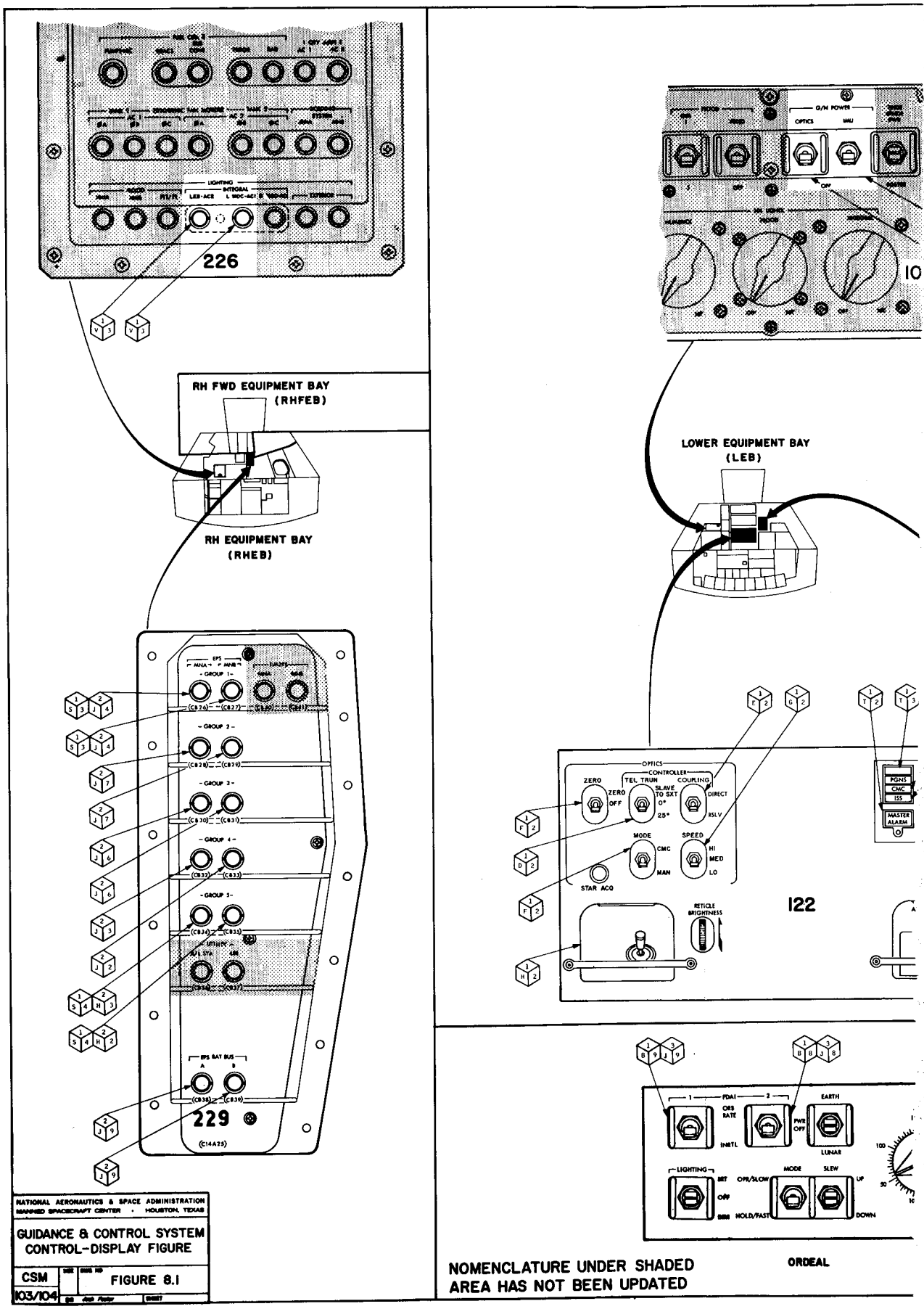
MEAS I.D.	MEAS DESCRIPTION	TM	CHAN CODE	DATA RANGE LOW	DATA RANGE HIGH	DATA RANGE UNITS	INST BUS	SIG COND	PWR RQMTS	O. B. DISPL	SIG DIST	DWG CSMSH
CT0012X	DSE TAPE MOTION	E2	11E14-5	OFF	MOTION	EVENT	DSE	--	--	--	--	7.1
CT0015V	SCE POS SUPPLY VOLTS	H2	11A148	0	+30	VDC	SCE	--	--	--	--	7.1
CT0016V	SCE NEG SUPPLY VOLTS	H2	11A154	0	-30	VDC	SCE	--	--	--	--	7.1
CT0017V	SENSOR EXCITATION 5 VOLTS	H2	11A119	0	+9	VDC	SCE	--	--	--	--	7.1
CT0018V	SENSOR EXCITATION 10 VOLTS	H2	11A120	0	+15	VDC	SCE	--	--	--	--	7.1
CT0120X	PCM BIT RATE CHANGE 8-BIT	D2	--	--	--	--	PCM	--	--	--	--	7.1
CT0125V	PCM HI LEVEL 85 PCT REF	H2	11A48	0	+5	VDC	PCM	--	--	--	--	7.1
CT0126V	PCM HI LEVEL 15 PCT REF	H2	11A49	0	+1.0	VDC	PCM	--	--	--	--	7.1
CT0145F	CTE TIME FROM LAUNCH 32-BIT	D2	11D2	--	--	--	CTE	--	--	--	--	7.1
CT0262V	UDL VALIDITY SIG 4-BIT	D2	51D	--	--	--	UDL	--	--	--	--	6.5
CT0340X	PCM SYNC SOURCE EXT OR INT	E1	11E32-8	INT	EXT	EVENT	PCM	--	--	--	--	7.1
CT0620E	USB RCVR AGC VOLTAGE	H2	11A121	-130	-50	DBM	S-BND	--	--	M	SS	6.2
CT0640F	USB RCVR PHASE ERR	H1	11A50	-90K	+90K	HZ	S-BND	--	--	--	--	6.2
ST0820K	PROTON CT RATE CHAN 1	H1	11A17	1	100K	C/S	V_{3S}	--	--	--	--	
ST0821K	PROTON CT RATE CHAN 2	H1	11A18	0.1	10K	C/S	V_{3S}	--	--	--	--	
ST0822K	PROTON CT RATE CHAN 3	H1	11A19	0.1	10K	C/S	V_{3S}	--	--	--	--	
ST0823K	PROTON CT RATE CHAN 4	H1	11A20	0.1	10K	C/S	V_{3S}	--	--	--	--	
ST0830K	ALPHA CT RATE CHAN 1	H1	11A38	0.1	10K	C/S	V_{3S}	--	--	--	--	
ST0831K	ALPHA CT RATE CHAN 2	H1	11A41	0.1	10K	C/S	V_{3S}	--	--	--	--	
ST0832K	ALPHA CT RATE CHAN 3	H1	11A42	0.1	10K	C/S	V_{3S}	--	--	--	--	
ST0838K	PROTON INTEG CT RATE	H1	11A43	1	100K	C/S	V_{3S}	--	--	--	--	
ST0840T	NUCLEAR PARTICLE DET TEMP	H1	10A61	-109	+140	DEG F	V_{4S}	--	--	--	--	
ST0841T	NUCLEAR PARTICLE ANAL TEMP	H1	10A62	-109	+140	DEG F	V_{4S}	--	--	--	--	

8 GUIDANCE AND CONTROL SYSTEM


1
2
ENTRY
RNG SET
FUNCTION
LAUNCH
AUTO
STBY
MODE
MAN
VELOCITY
GTA
ΔV/EMS SET
INCR
DECR
ΔV/RANGE
ABORT
UPLINK ACTY
TEMP
NO ATT
GIMBAL LOCK
STBY
PROG
KEY REL
RESTART
OPR ERR
TRACKER
COMP ACTY
PROG
VERB
NOUN
UP TLM ACCEPT
BLOCK
LV TANK PRESS
S-IVB OXID
S-IVB FUEL
PITCH
SPS GIMBAL
YAW
ΔV CG LM/CSM
LV GUIDANCE IU
CMC
RESET/OVERRIDE
DOWN
UP
LIGHTS


MAIN DISPLAY CONSOLE
(MDC)
ORDEAL
GUIDANCE/NAVIGATION
POWER
AC1
AC2
IMU
MNA
MNB
COMPUTER
OPTICS
MASTER ALARM
5
7


STAB CONT SYSTEM
TVC AC 1
AC 1
AC 2
A/C ROLL
B/D ROLL
AUTO RCS SELECT
PITCH
STABILIZATION CONTROL SYSTEM
DIRECT ULL
DIRECT
YAW
REACTION CONTROL SYSTEM
BCS LOGIC
EMS
SERVICE PROPULSION SYSTEM
PILOT VLVS
UPLINK ACTY
TEMP
NO ATT
GIMBAL LOCK
STBY
PROG
KEY REL
RESTART
OPR ERR
TRACKER
COMP ACTY
PROG
VERB
NOUN
88
31
33
+58944
+35870
-83614
140
VERB
NOUN
CLR
ENTR
STBY
RSET
KEY REL
ACCEPT
REJECT
MARK REJECT
IMPULSE ROLLER
ON
OFF
TEST
ACCEPT
REJECT
ELECTRONICS PWR
SCS
CMC
GDC/ECA
MAG POWER
WARM UP
FDAI/GDC POWER
ATT/ANG
SCS COMPUTER BIAS PWR
AC 1
AC 2
OFF
ON
GDC POWER
STOWED WHEN NOT IN USE. MOUNTED ABOVE PNL 1 WHEN IN USE



NOMENCLATURE UNDER SHADED AREA HAS NOT BEEN UPDATED

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS

GUIDANCE & CONTROL SYSTEM CONTROL-DISPLAY FIGURE

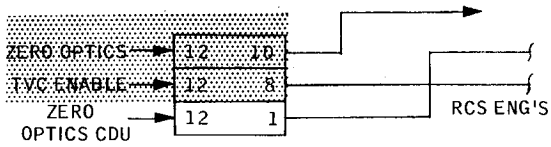
CSM 103/104

FIGURE 8.1

SECTION 8

IS

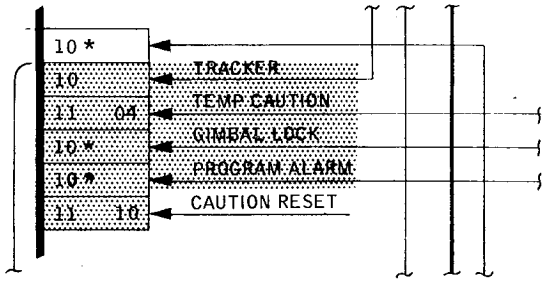
1. DWG 8.1 J Z 3



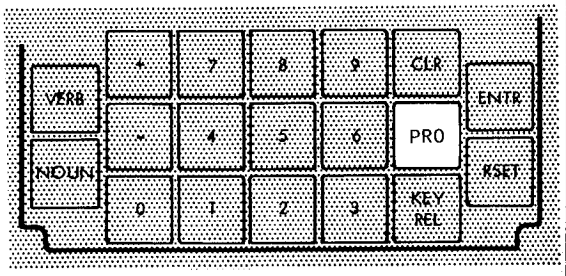
2. DWG 8.1 M Z 6

T4 RUPT ROUTINE

3. DWG 8.1 M Z 5



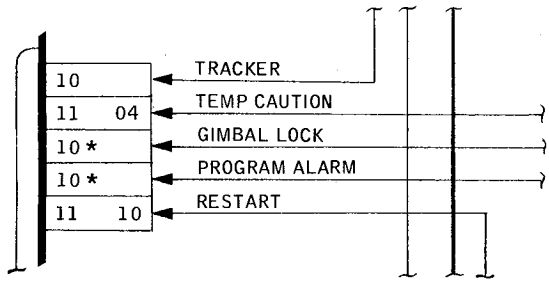
4. DWG 8.1 0 Z 4

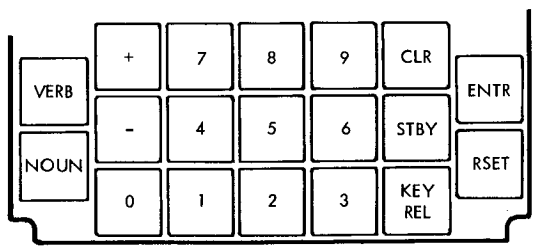


WAS

ZERO OPTICS 12 10
TVC ENABLE 12 8
RCS ENG'S

T4 RUFT ROUTINE

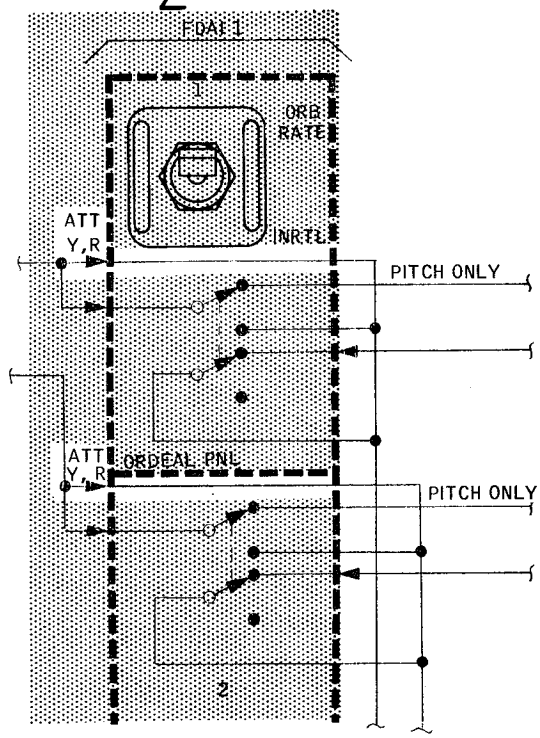




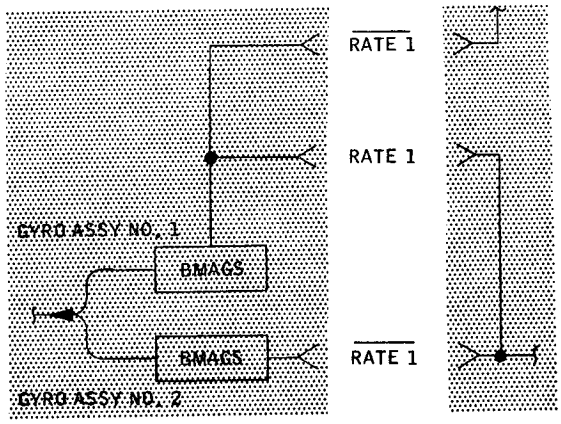
SECTION 8

IS

5. DWG 8.1 B Z 9



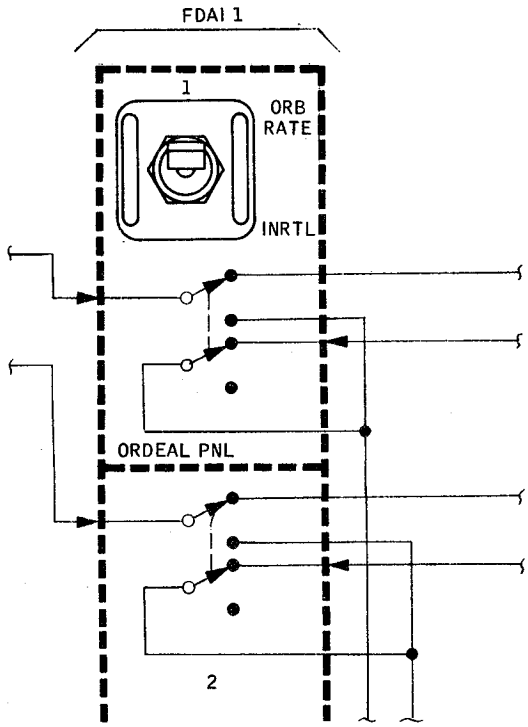
6. DWG 8.1 D Z 7

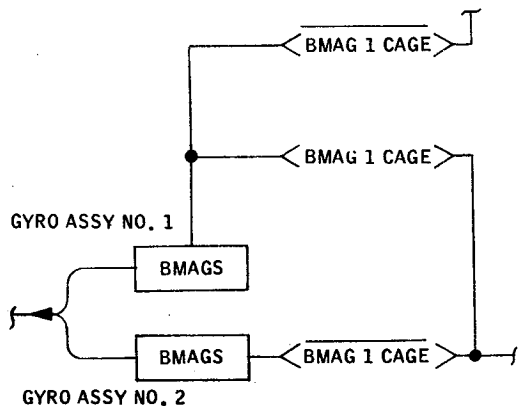


7. DWG 8.1 I Z 9

126° F < PLATFORM TEMP < 134° F

WAS



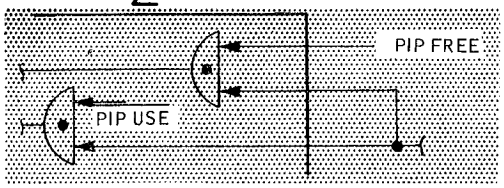


126° F > PLATFORM TEMP > 134° F

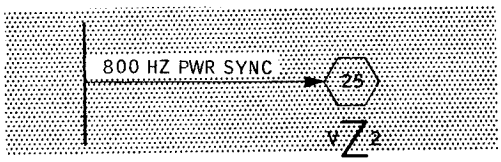
SECTION 8

IS

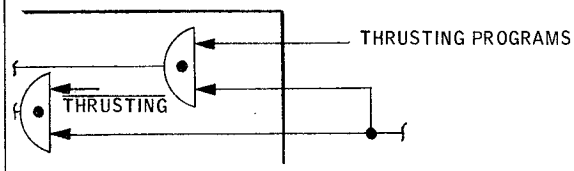
8. DWG 8.1 L Z 6

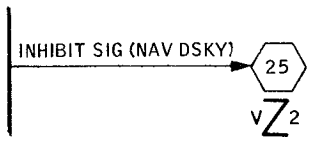


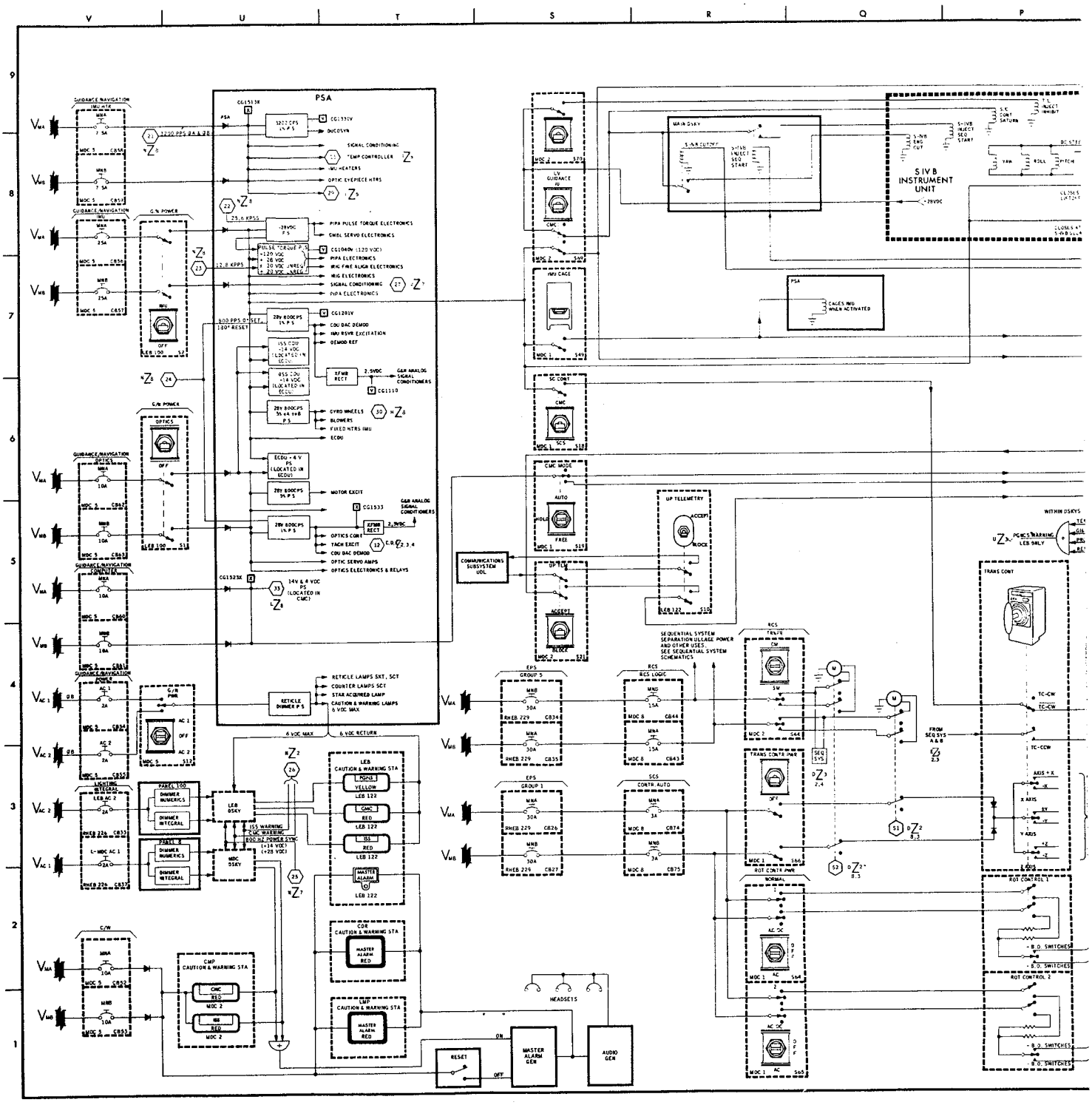
9. DWG 8.1 N Z 4

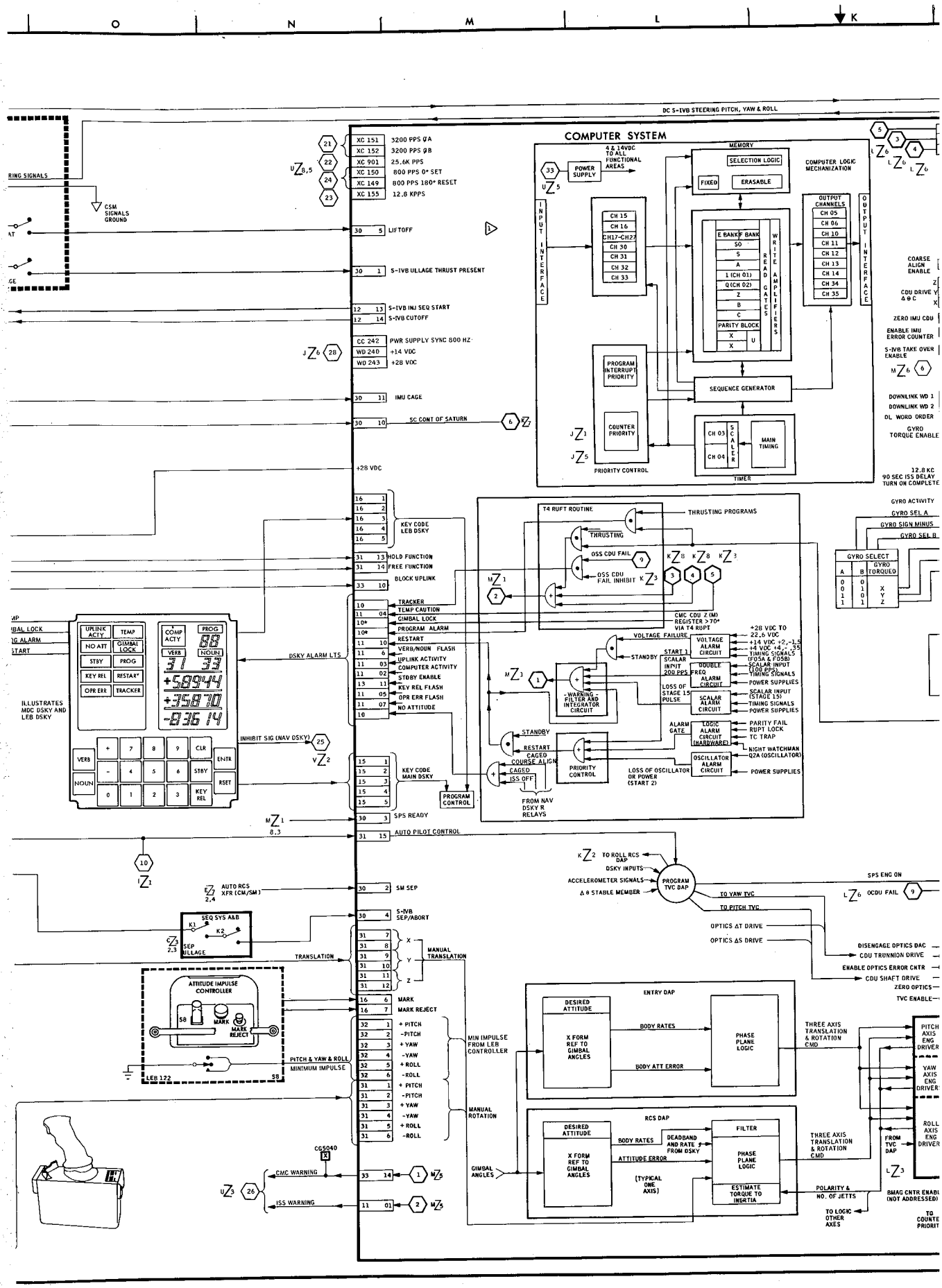


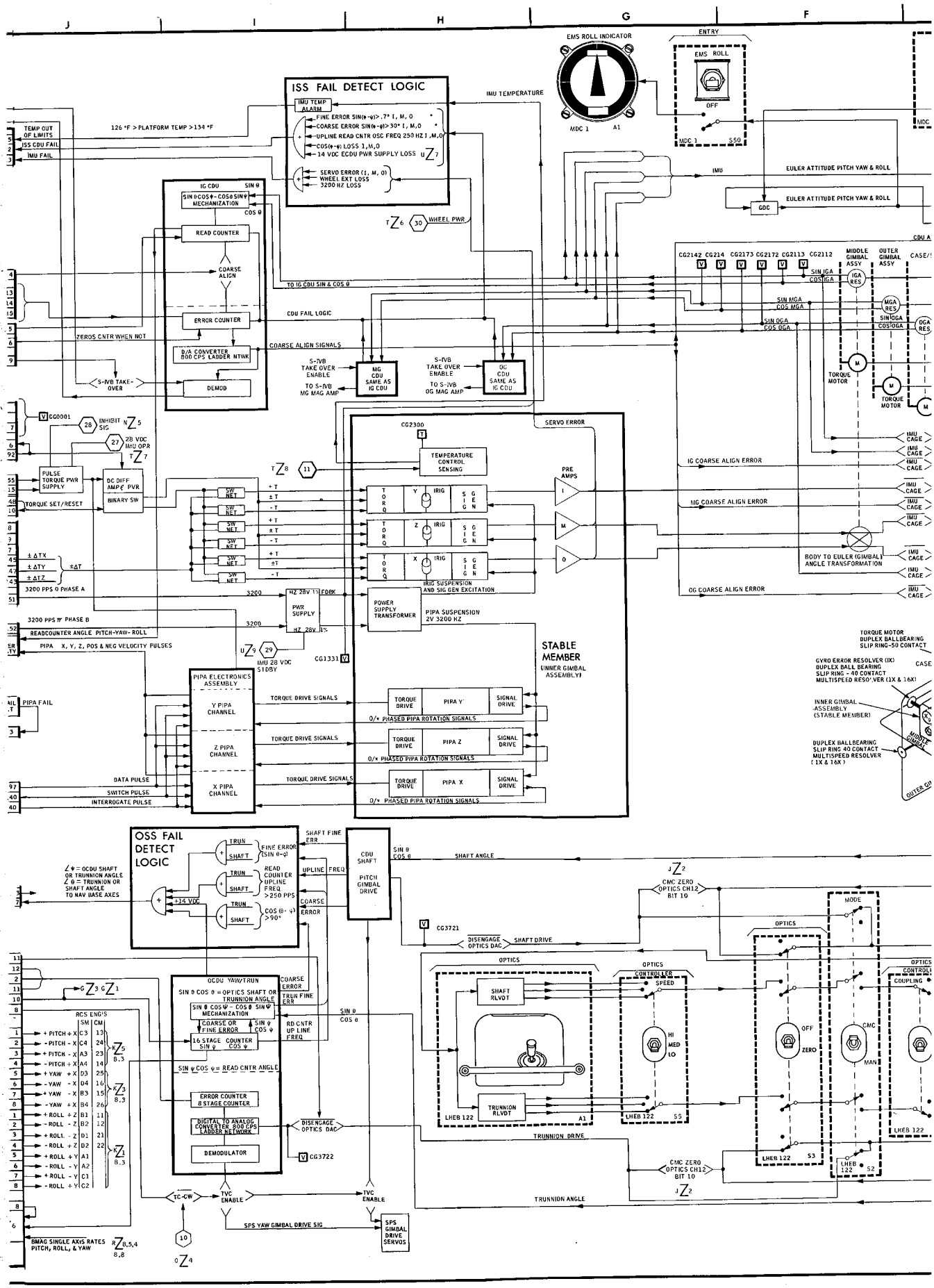
WAS

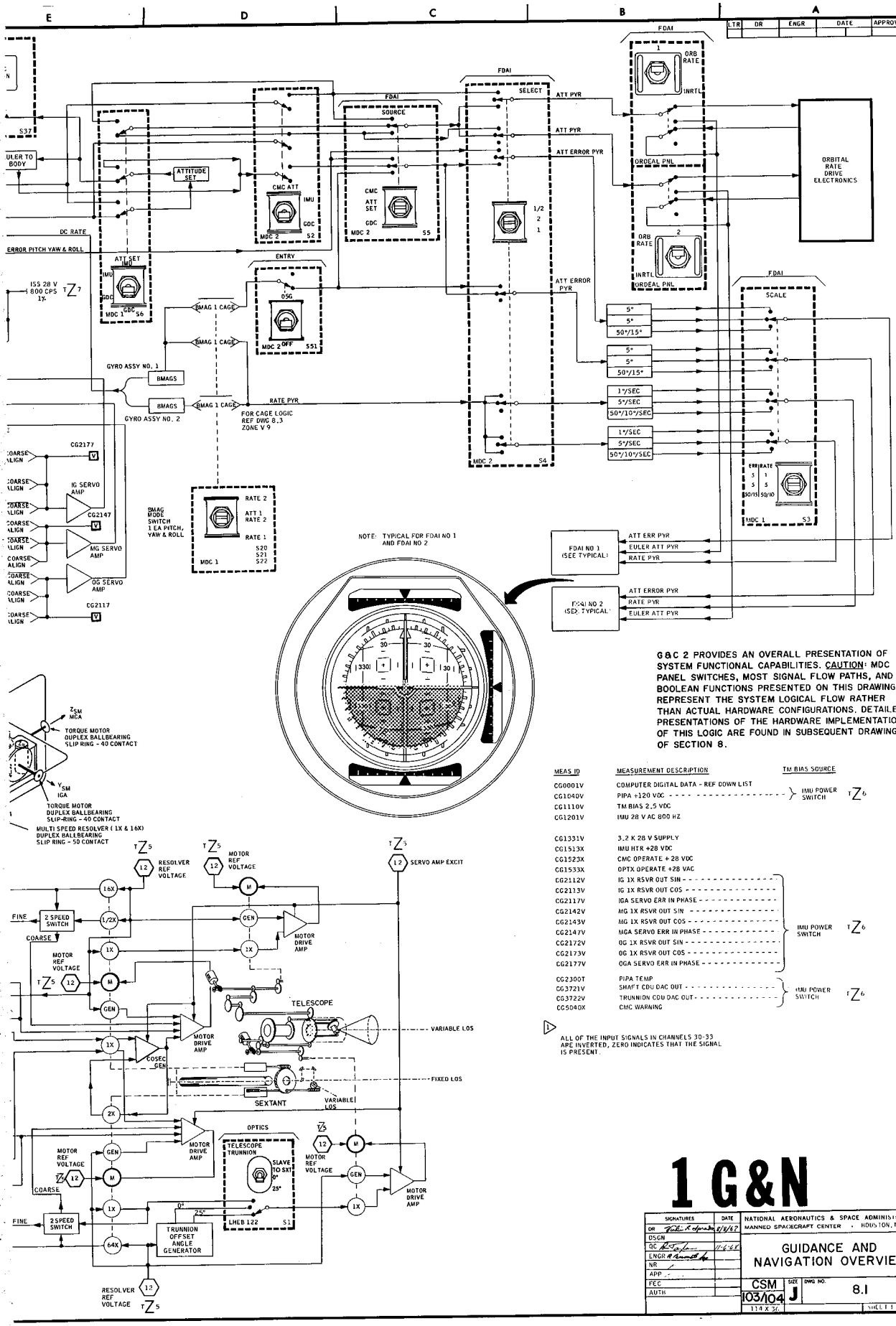





PSA
S IVB INSTRUMENT UNIT
MAIN DSKY
PSA
CAGES IMU WHEN ACTIVATED
SEQUENTIAL SYSTEM SEPARATION ULLAGE POWER AND OTHER USES. SEE SEQUENTIAL SYSTEM SCHEMATICS
TRANS CONT
ROT CONTROL 1
ROT CONTROL 2
MASTER ALARM GEN
AUDIO GEN
RESET
HEADSETS
COMMUNICATIONS SUBSYSTEM UDL
UP TELEMETRY
CMC MODE
SC CONT
LEB CAUTION & WARNING STA
CMP CAUTION & WARNING STA
CDR CAUTION & WARNING STA
LMP CAUTION & WARNING STA
RCS TRIPR
RCS LOGIC
EPS GROUP 5
EPS GROUP 1
SCS CONTR AUTO
TRANS CONTR PWR
ROT CONTR PWR
G/N POWER
C/W
LIGHTING INTEGRAL
PANEL 100
PANEL 8
WITHIN DSKYS
PGNCS WARNING
LEB ONLY
TC-CW
TC-CCW
AXIS +X
X AXIS
Y AXIS
+Z
-Z
+Y
-Y
R.O. SWITCHES
FROM SEQ SYS A & B
SEQ SYS


O
N
M
L
K
DC S-IVB STEERING PITCH, YAW & ROLL
COMPUTER SYSTEM
4 & 14VDC TO ALL FUNCTIONAL AREAS
POWER SUPPLY
MEMORY
SELECTION LOGIC
FIXED
ERASABLE
COMPUTER LOGIC MECHANIZATION
INPUT INTERFACE
OUTPUT INTERFACE
OUTPUT CHANNELS
CH 05
CH 06
CH 10
CH 11
CH 12
CH 13
CH 14
CH 34
CH 35
CH 15
CH 16
CH17-CH27
CH 30
CH 31
CH 32
CH 33
E BANK
F BANK
SQ
S
A
1 (CH 01)
Q (CH 02)
Z
B
C
PARITY BLOCK
X
U
READ GATES
WRITE AMPLIFIERS
PROGRAM INTERRUPT PRIORITY
COUNTER PRIORITY
PRIORITY CONTROL
SEQUENCE GENERATOR
CH 03
CH 04
SCALER
MAIN TIMING
TIMER
XC 151 3200 PPS ØA
XC 152 3200 PPS ØB
XC 901 25.6K PPS
XC 150 800 PPS 0° SET
XC 149 800 PPS 180° RESET
XC 155 12.8 KPPS
30 5 LIFTOFF
30 1 S-IVB ULLAGE THRUST PRESENT
12 13 S-IVB INJ SEQ START
12 14 S-IVB CUTOFF
CC 242 PWR SUPPLY SYNC 800 HZ
WD 240 +14 VDC
WD 243 +28 VDC
30 11 IMU CAGE
30 10 SC CONT OF SATURN
+28 VDC
KEY CODE LEB DSKY
31 13 HOLD FUNCTION
31 14 FREE FUNCTION
33 10 BLOCK UPLINK
TRACKER
TEMP CAUTION
GIMBAL LOCK
PROGRAM ALARM
RESTART
VERB/NOUN FLASH
UPLINK ACTIVITY
COMPUTER ACTIVITY
STBY ENABLE
KEY REL FLASH
OPR ERR FLASH
NO ATTITUDE
DSKY ALARM LTS
INHIBIT SIG (NAV DSKY)
KEY CODE MAIN DSKY
PROGRAM CONTROL
30 3 SPS READY
31 15 AUTO PILOT CONTROL
ILLUSTRATES MDC DSKY AND LEB DSKY
UPLINK ACTY
TEMP
NO ATT
GIMBAL LOCK
STBY
PROG
KEY REL
RESTART
OPR ERR
TRACKER
COMP ACTY
PROG
VERB
NOUN
VERB
NOUN
CLR
ENTR
STBY
RSET
KEY REL
T4 RUPT ROUTINE
THRUSTING PROGRAMS
THRUSTING
OSS CDU FAIL
OSS CDU FAIL INHIBIT
CMC CDU Z (M) REGISTER >70° VIA T4 RUPT
+28 VDC TO 22.6 VDC
VOLTAGE FAILURE
STANDBY
START 1
VOLTAGE ALARM CIRCUIT
+14 VDC +2,-1.5
+4 VDC +4, -.35
TIMING SIGNALS (F05A & F05B)
SCALAR INPUT (100 PPS)
POWER SUPPLIES
SCALAR INPUT 200 PPS
DOUBLE FREQ ALARM CIRCUIT
LOSS OF STAGE 1S PULSE
SCALAR ALARM CIRCUIT
SCALAR INPUT (STAGE 1S)
- WARNING - FILTER AND INTEGRATOR CIRCUIT
ALARM GATE
LOGIC ALARM CIRCUIT (HARDWIRE)
PARITY FAIL
RUPT LOCK
TC TRAP
NIGHT WATCHMAN
Q2A (OSCILLATOR)
OSCILLATOR ALARM CIRCUIT
LOSS OF OSCILLATOR OR POWER (START 2)
STANDBY
RESTART
CAGED
COURSE ALIGN
CAGED
ISS OFF
FROM NAV DSKY R RELAYS
PRIORITY CONTROL
GYRO ACTIVITY
GYRO SEL A
GYRO SIGN MINUS
GYRO SEL B
GYRO SELECT
GYRO TORQUED
A
B
X
Y
Z
AUTO RCS XFR (CM/SM)
SEQ SYS A&B
K1
K2
SEP ULLAGE
SM SEP
S-IVB SEP/ABORT
TRANSLATION
MANUAL TRANSLATION
X
Y
Z
ATTITUDE IMPULSE CONTROLLER
S8
MARK
MARK REJECT
LEB 122
PITCH & YAW & ROLL MINIMUM IMPULSE
MARK
MARK REJECT
+ PITCH
-PITCH
+ YAW
-YAW
+ ROLL
-ROLL
MIN IMPULSE FROM LEB CONTROLLER
MANUAL ROTATION
CG5040
CMC WARNING
ISS WARNING
TO ROLL RCS DAP
DSKY INPUTS
ACCELEROMETER SIGNALS
Δ θ STABLE MEMBER
PROGRAM TVC DAP
SPS ENG ON
TO YAW TVC
TO PITCH TVC
OPTICS ΔT DRIVE
OPTICS ΔS DRIVE
DISENGAGE OPTICS DAC
CDU TRUNNION DRIVE
ENABLE OPTICS ERROR CNTR
CDU SHAFT DRIVE
ZERO OPTICS
TVC ENABLE
ENTRY DAP
DESIRED ATTITUDE
X FORM REF TO GIMBAL ANGLES
BODY RATES
BODY ATT ERROR
PHASE PLANE LOGIC
THREE AXIS TRANSLATION & ROTATION CMD
RCS DAP
DESIRED ATTITUDE
X FORM REF TO GIMBAL ANGLES
BODY RATES
DEADBAND AND RATE FROM DSKY
ATTITUDE ERROR
(TYPICAL ONE AXIS)
FILTER
PHASE PLANE LOGIC
ESTIMATE TORQUE TO INERTIA
GIMBAL ANGLES
POLARITY & NO. OF JETTS
TO LOGIC OTHER AXES
THREE AXIS TRANSLATION & ROTATION CMD
FROM TVC DAP
PITCH AXIS ENG DRIVER
YAW AXIS ENG DRIVER
ROLL AXIS ENG DRIVER
OCDU FAIL
COARSE ALIGN ENABLE
CDU DRIVE Y
ZERO IMU CDU
ENABLE IMU ERROR COUNTER
S-IVB TAKE OVER ENABLE
DOWNLINK WD 1
DOWNLINK WD 2
DL WORD ORDER
GYRO TORQUE ENABLE
12.8 KC 90 SEC ISS DELAY TURN ON COMPLETE
RING SIGNALS
CSM SIGNALS GROUND


ISS FAIL DETECT LOGIC
IMU TEMP ALARM
FINE ERROR SIN(θ-φ)>.7° 1, M, 0
COARSE ERROR SIN(θ-φ)>30° 1, M, 0
UPLINE READ CNTR OSC FREQ 250 HZ 1, M, 0
COS(θ-φ) LOSS 1, M, 0
14 VDC ECDU PWR SUPPLY LOSS
SERVO ERROR (1, M, 0)
WHEEL EXT LOSS
3200 HZ LOSS
IMU TEMPERATURE
EMS ROLL INDICATOR
ENTRY
EMS ROLL
OFF
TEMP OUT OF LIMITS
ISS CDU FAIL
IMU FAIL
126 °F > PLATFORM TEMP > 134 °F
IMU
EULER ATTITUDE PITCH YAW & ROLL
GDC
IG CDU
SIN θ
SIN θ COS ψ - COS θ SIN ψ MECHANISM
COS θ
READ COUNTER
COARSE ALIGN
ERROR COUNTER
D/A CONVERTER 800 CPS LADDER NTWK
DEMOD
ZEROS CNTR WHEN NOT
S-IVB TAKE-OVER
TO IG CDU SIN & COS θ
CDU FAIL LOGIC
COARSE ALIGN SIGNALS
MG CDU SAME AS IG CDU
OG CDU SAME AS IG CDU
S-IVB TAKE OVER ENABLE
TO S-IVB MG MAG AMP
TO S-IVB OG MAG AMP
WHEEL PWR
CDU A
CG2142 CG214 CG2173 CG2172 CG2113 CG2112
MIDDLE GIMBAL ASSY
OUTER GIMBAL ASSY
SIN IGA
COS IGA
SIN MGA
COS MGA
SIN OGA
COS OGA
IGA RES
MGA RES
OGA RES
TORQUE MOTOR
CG0001
INHIBIT SIG
28 VDC IMU OPR
PULSE TORQUE PWR SUPPLY
DC DIFF AMP & PWR BINARY SW
TORQUE SET/RESET
3200 PPS Ø PHASE A
3200 PPS Ø PHASE B
READCOUNTER ANGLE PITCH-YAW-ROLL
PIPA X, Y, Z, POS & NEG VELOCITY PULSES
IMU 28 VDC STDBY
CG2300
TEMPERATURE CONTROL SENSING
SERVO ERROR
PRE AMPS
IG COARSE ALIGN ERROR
MG COARSE ALIGN ERROR
OG COARSE ALIGN ERROR
BODY TO EULER (GIMBAL) ANGLE TRANSFORMATION
IMU CAGE
IRIG SUSPENSION AND SIG GEN EXCITATION
POWER SUPPLY TRANSFORMER
PIPA SUSPENSION 2V 3200 HZ
PWR SUPPLY
FDBK
CG1331
STABLE MEMBER
(INNER GIMBAL ASSEMBLY)
PIPA ELECTRONICS ASSEMBLY
Y PIPA CHANNEL
Z PIPA CHANNEL
X PIPA CHANNEL
PIPA FAIL
TORQUE DRIVE SIGNALS
TORQUE DRIVE
PIPA Y
PIPA Z
PIPA X
SIGNAL DRIVE
Ø/+ PHASED PIPA ROTATION SIGNALS
DATA PULSE
SWITCH PULSE
INTERROGATE PULSE
TORQUE MOTOR DUPLEX BALLBEARING SLIP RING-50 CONTACT
GYRO ERROR RESOLVER (IX) DUPLEX BALL BEARING SLIP RING - 40 CONTACT MULTISPEED RESOLVER (1X & 16X)
INNER GIMBAL ASSEMBLY (STABLE MEMBER)
DUPLEX BALLBEARING SLIP RING 40 CONTACT MULTISPEED RESOLVER (1X & 16X)
OSS FAIL DETECT LOGIC
TRUN
SHAFT
FINE ERROR (SIN θ-φ)
READ COUNTER UPLINE FREQ >250 PPS
COS (θ-φ) >90°
+14 VDC
∠ψ = OCDU SHAFT OR TRUNNION ANGLE
∠θ = TRUNNION OR SHAFT ANGLE TO NAV BASE AXES
SHAFT FINE ERR
UPLINE FREQ
COARSE ERROR
CDU SHAFT
PITCH GIMBAL DRIVE
SHAFT ANGLE
CMC ZERO OPTICS CH12 BIT 10
CG3721
DISENGAGE OPTICS DAC
SHAFT DRIVE
OPTICS
MODE
OPTICS CONTROLLER SPEED
HI MED LO
SHAFT RLVDT
TRUNNION RLVDT
OFF ZERO
CMC MAN
OPTICS COUPLING
LHEB 122
TRUNNION DRIVE
TRUNNION ANGLE
OCDU YAW/TRUN
SIN θ COS θ = OPTICS SHAFT OR TRUNNION ANGLE
SIN ψ COS ψ = READ CNTR ANGLE
16 STAGE COUNTER
ERROR COUNTER 8 STAGE COUNTER
DIGITAL TO ANALOG CONVERTER 800 CPS LADDER NETWORK
DEMODULATOR
CG3722
RCS ENGS
SM
CM
+ PITCH + X
- PITCH - X
+ PITCH - X
- PITCH + X
+ YAW + X
- YAW - X
+ YAW - X
- YAW + X
+ ROLL + Z
- ROLL - Z
+ ROLL - Z
+ ROLL + Z
+ ROLL + Y
- ROLL - Y
+ ROLL - Y
- ROLL + Y
TC-CW
TVC ENABLE
SPS YAW GIMBAL DRIVE SIG
SPS GIMBAL DRIVE SERVOS
BMAG SINGLE AXIS RATES PITCH, ROLL, & YAW



G&C 2 PROVIDES AN OVERALL PRESENTATION OF SYSTEM FUNCTIONAL CAPABILITIES. CAUTION: MDC PANEL SWITCHES, MOST SIGNAL FLOW PATHS, AND BOOLEAN FUNCTIONS PRESENTED ON THIS DRAWING REPRESENT THE SYSTEM LOGICAL FLOW RATHER THAN ACTUAL HARDWARE CONFIGURATIONS. DETAILED PRESENTATIONS OF THE HARDWARE IMPLEMENTATION OF THIS LOGIC ARE FOUND IN SUBSEQUENT DRAWINGS OF SECTION 8.

MEAS ID	MEASUREMENT DESCRIPTION	TM BIAS SOURCE
CG0001V	COMPUTER DIGITAL DATA - REF DOWN LIST	IMU POWER SWITCH
CG1040V	PIPA +120 VDC	
CG1110V	TM BIAS 2.5 VDC	
CG1201V	IMU 28 V AC 800 HZ	
CG1331V	3.2 K 28 V SUPPLY	
CG1513X	IMU HTR +28 VDC	
CG1523X	CMC OPERATE + 28 VDC	
CG1533X	OPTX OPERATE +28 VAC	
CG2112V	IG 1X RSVR OUT SIN	IMU POWER SWITCH
CG2113V	IG 1X RSVR OUT COS	
CG2117V	IGA SERVO ERR IN PHASE	
CG2142V	MG 1X RSVR OUT SIN	
CG2143V	MG 1X RSVR OUT COS	
CG2147V	MGA SERVO ERR IN PHASE	
CG2172V	OG 1X RSVR OUT SIN	
CG2173V	OG 1X RSVR OUT COS	
CG2177V	OGA SERVO ERR IN PHASE	
CG2300T	PIPA TEMP	IMU POWER SWITCH
CG3721V	SHAFT CDU DAC OUT	
CG3722V	TRUNNION CDU DAC OUT	
CG5040X	CMC WARNING	

1 ALL OF THE INPUT SIGNALS IN CHANNELS 30-33 ARE INVERTED, ZERO INDICATES THAT THE SIGNAL IS PRESENT.

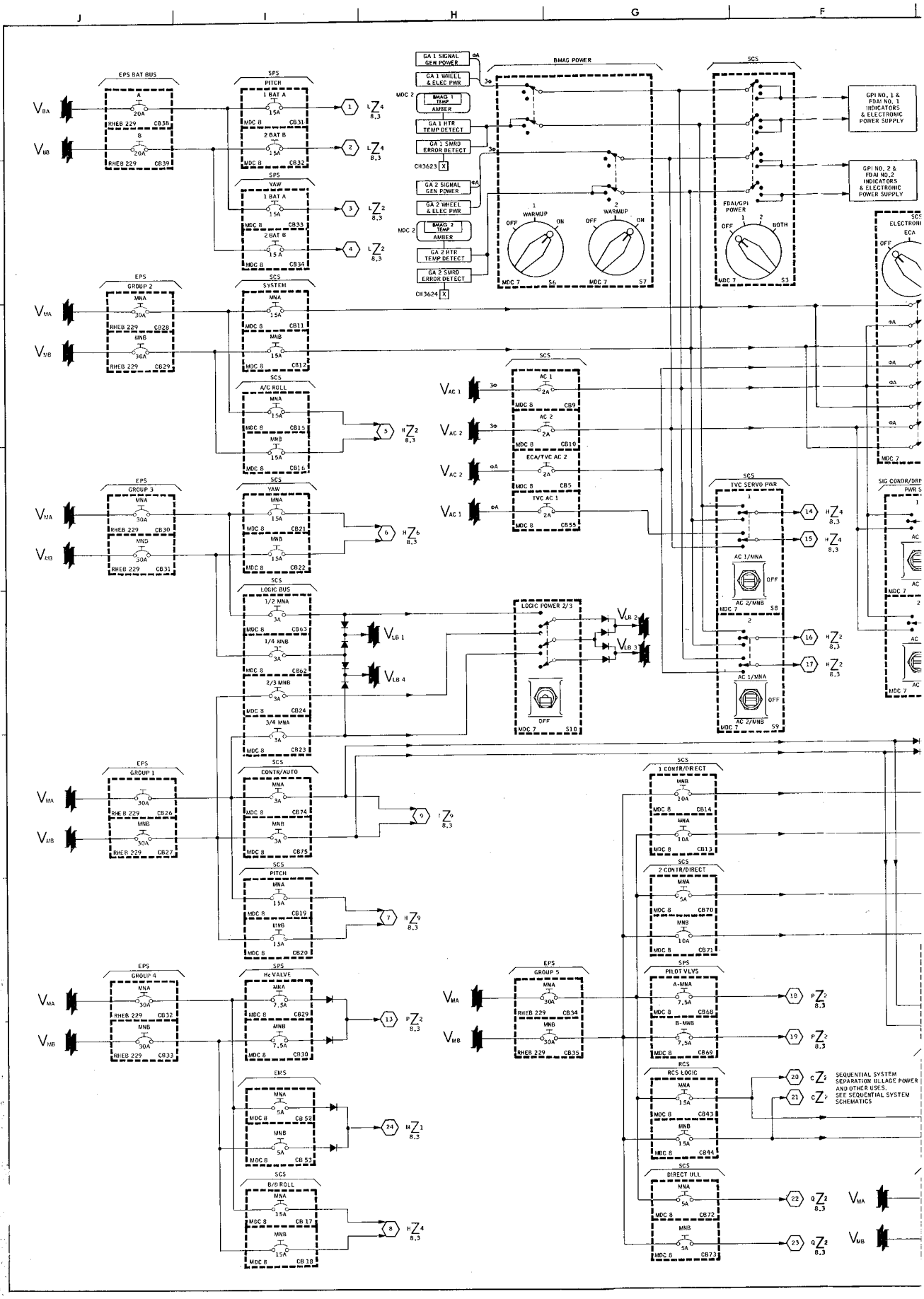
1 G&N

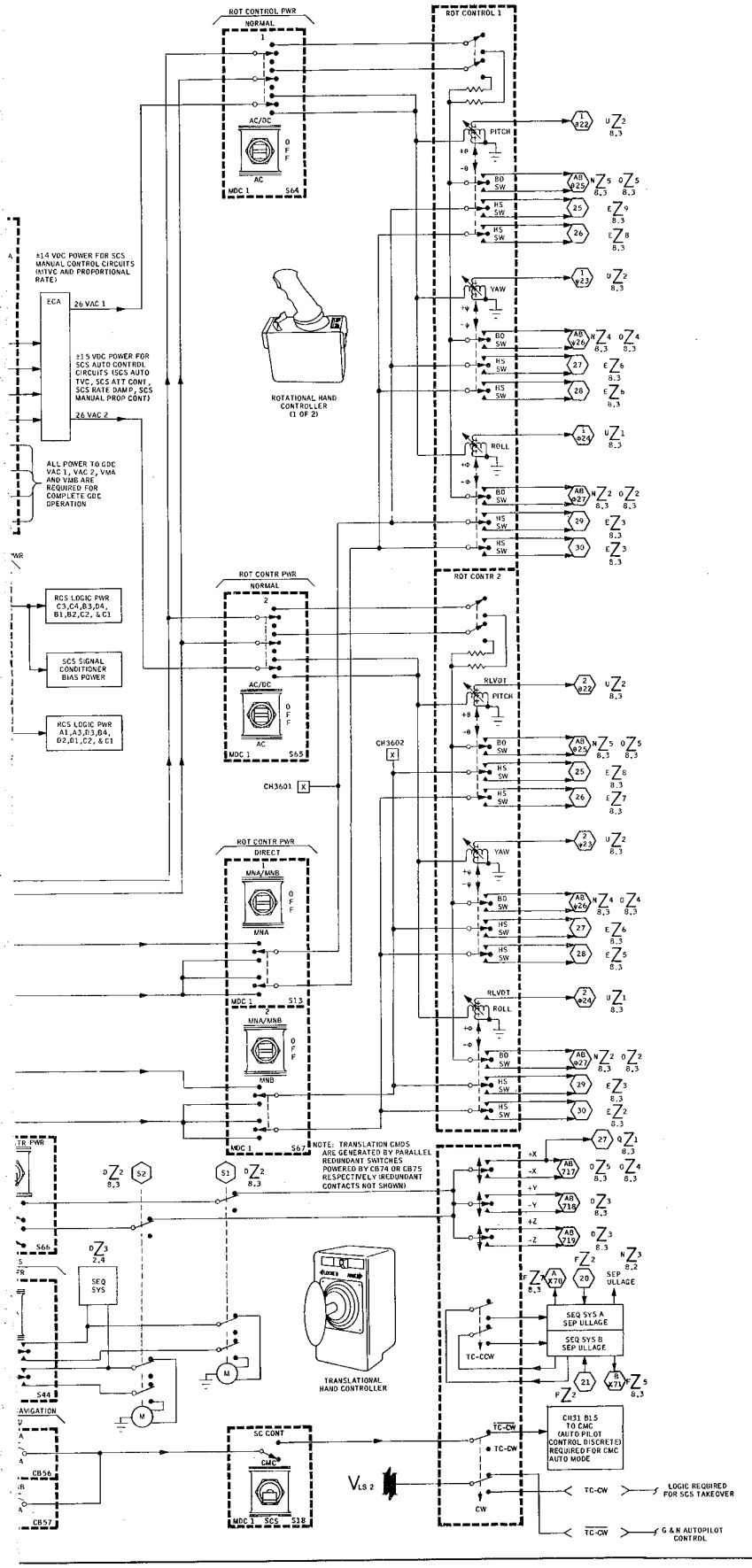
SIGNATURES	DATE
DR	8/8/62
DSGN	
QC	11-6-62
ENGR	
NR	
APP	
FEC	
AUTH	

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER . HOUSTON, TEXAS

GUIDANCE AND NAVIGATION OVERVIEW

CSM 103/104 | SIZE J | DWG NO. 8.1 | 11 X 36 | SHEET 1 OF 1


J
I
H
G
F
EPS BAT BUS
A
20A
RHEB 229 CB38
B
20A
RHEB 229 CB39
SPS
PITCH
1 BAT A
15A
MDC 8 CB31
2 BAT B
15A
MDC 8 CB32
SPS
YAW
1 BAT A
15A
MDC 8 CB33
2 BAT B
15A
MDC 8 CB34
GA 1 SIGNAL GEN PWR
GA 1 WHEEL & ELEC PWR
BMAG 1 TEMP AMBER
MDC 2
GA 1 HTR TEMP DETECT
GA 1 SMRD ERROR DETECT
CH3623
GA 2 SIGNAL GEN POWER
GA 2 WHEEL & ELEC PWR
BMAG 2 TEMP AMBER
MDC 2
GA 2 HTR TEMP DETECT
GA 2 SMRD ERROR DETECT
CH3624
BMAG POWER
WARMUP
OFF
ON
MDC 7 S6
MDC 7 S7
SCS
FDAI/GPI POWER
OFF
1
2
BOTH
MDC 7 S3
GPI NO. 1 & FDAI NO. 1 INDICATORS & ELECTRONIC POWER SUPPLY
GPI NO. 2 & FDAI NO. 2 INDICATORS & ELECTRONIC POWER SUPPLY
EPS
GROUP 2
MNA
30A
RHEB 229 CB28
MNB
30A
RHEB 229 CB29
SCS
SYSTEM
MNA
15A
MDC 8 CB11
MNB
15A
MDC 8 CB12
SCS
A/C ROLL
MNA
15A
MDC 8 CB15
MNB
15A
MDC 8 CB16
SCS
AC 1
2A
MDC 8 CB9
AC 2
2A
MDC 8 CB10
ECA/TVC AC 2
2A
MDC 8 CB5
TVC AC 1
2A
MDC 8 CB55
EPS
GROUP 3
MNA
30A
RHEB 229 CB30
MNB
30A
RHEB 229 CB31
SCS
YAW
MNA
15A
MDC 8 CB21
MNB
15A
MDC 8 CB22
SCS
TVC SERVO PWR
AC 1/MNA
OFF
AC 2/MNB
MDC 7 S8
AC 1/MNA
OFF
AC 2/MNB
MDC 7 S9
SCS
LOGIC BUS
1/2 MNA
3A
MDC 8 CB63
1/4 MNB
3A
MDC 8 CB62
2/3 MNB
3A
MDC 8 CB24
3/4 MNA
3A
MDC 8 CB23
LOGIC POWER 2/3
OFF
MDC 7 S10
EPS
GROUP 1
MNA
30A
RHEB 229 CB26
MNB
30A
RHEB 229 CB27
SCS
CONTR/AUTO
MNA
3A
MDC 8 CB74
MNB
3A
MDC 8 CB75
SCS
PITCH
MNA
15A
MDC 8 CB19
MNB
15A
MDC 8 CB20
SCS
1 CONTR/DIRECT
MNB
10A
MDC 8 CB14
MNA
10A
MDC 8 CB13
SCS
2 CONTR/DIRECT
MNA
5A
MDC 8 CB70
MNB
10A
MDC 8 CB71
EPS
GROUP 4
MNA
30A
RHEB 229 CB32
MNB
30A
RHEB 229 CB33
SPS
RCVALVE
MNA
7.5A
MDC 8 CB29
MNB
7.5A
MDC 8 CB30
EMS
MNA
5A
MDC 8 CB 52
MNB
5A
MDC 8 CB 53
SCS
B/B ROLL
MNA
15A
MDC 8 CB 17
MNB
15A
MDC 8 CB 18
EPS
GROUP 5
MNA
30A
RHEB 229 CB34
MNB
30A
RHEB 229 CB35
SPS
PILOT VLVS
A-MNA
7.5A
MDC 8 CB68
B-MNB
7.5A
MDC 8 CB69
RCS
RCS LOGIC
MNA
15A
MDC 8 CB43
MNB
15A
MDC 8 CB44
SCS
DIRECT ULL
MNA
5A
MDC 8 CB72
MNB
5A
MDC 8 CB73
SEQUENTIAL SYSTEM SEPARATION ULLAGE POWER AND OTHER USES. SEE SEQUENTIAL SYSTEM SCHEMATICS
SCS
ELECTRONI
ECA
OFF
SIG CONDR/DRI
PWR S
AC
MDC 7



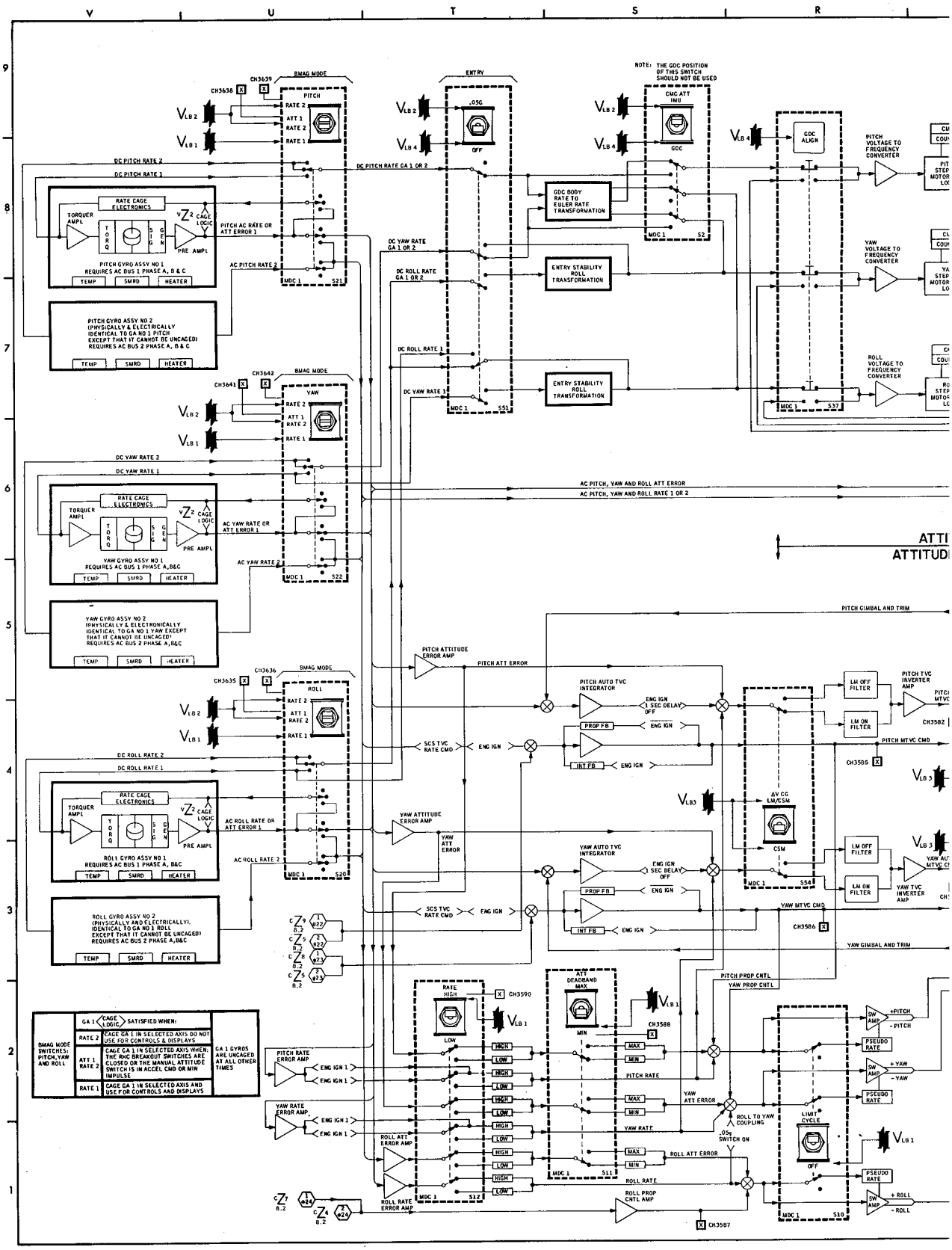
2 SCS

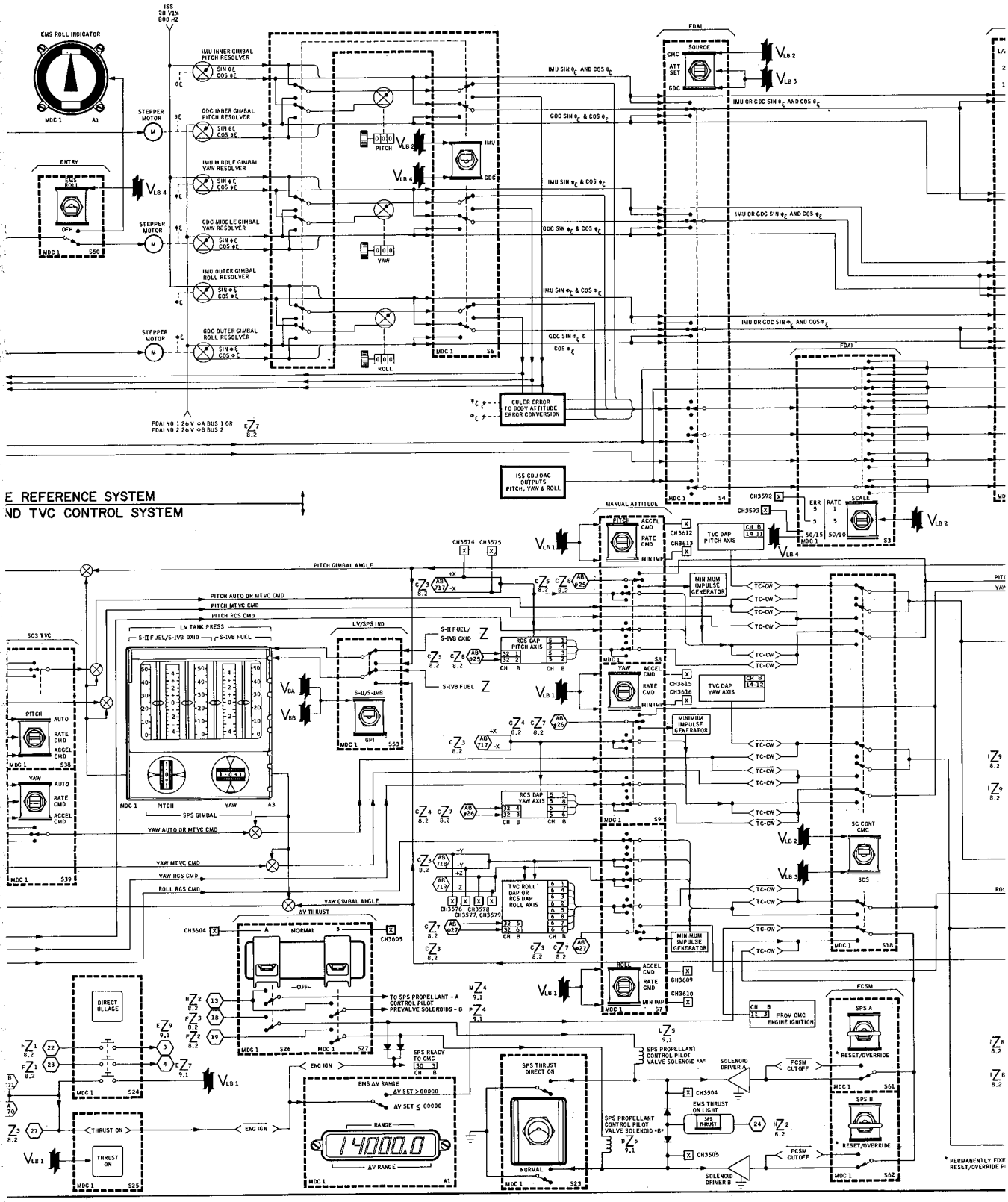
SIGNATURES	DATE	NATIONAL AERONAUTICS & SPACE ADMINISTRATION
DR		MANNED SPACECRAFT CENTER - HOUSTON, TEXAS
DSGN		
QC	11-6-67	STABILIZATION CONTROL SYSTEM OVERVIEW (POWER)
ENGR	11-6-67	
NR	11-6-67	
APP	11-6-67	103/104 SIZE J DWG NO 8.2
FEC		CSM PAGE SHEET OF
AUTH		

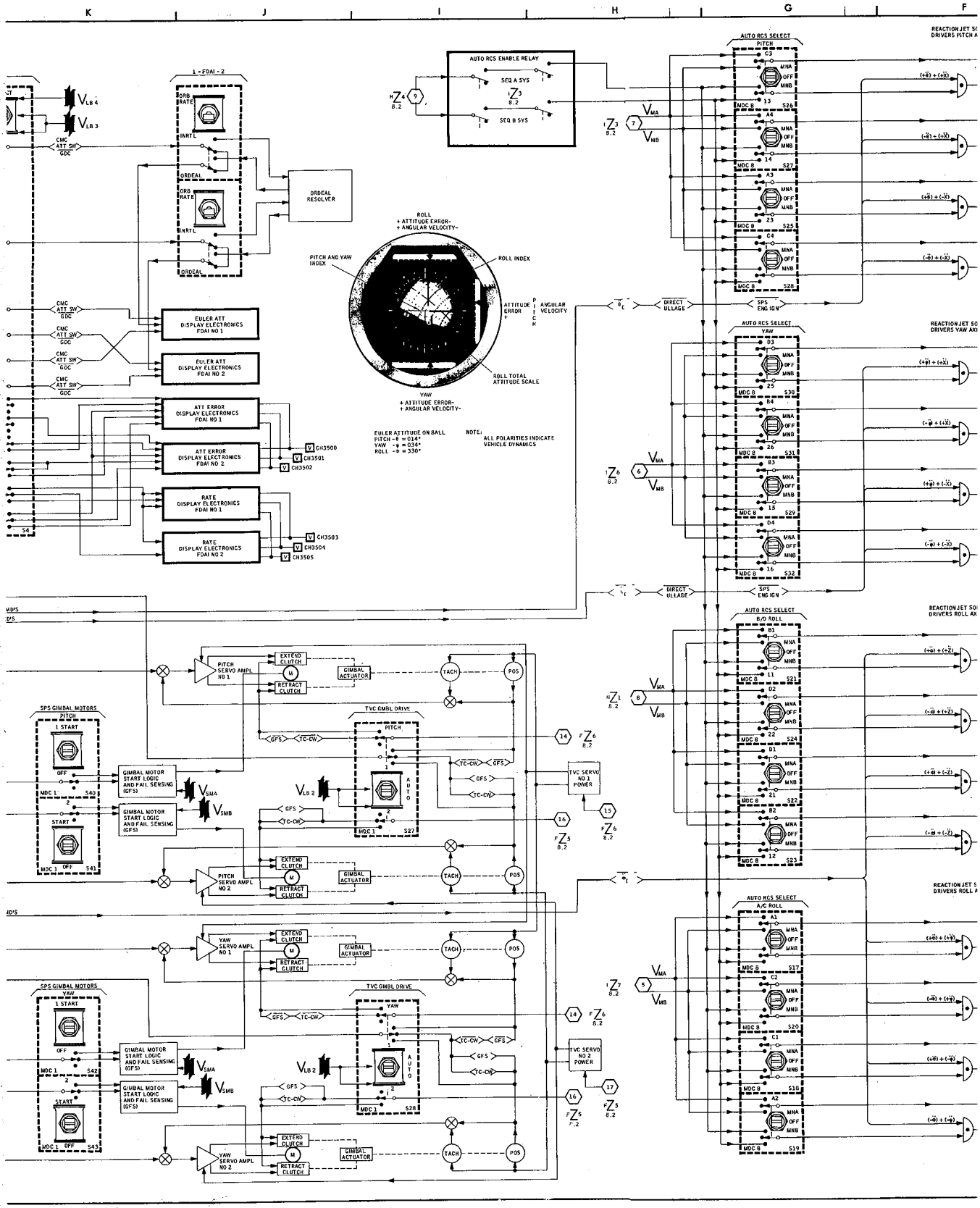
* SCS SIGNAL AND POWER CODE

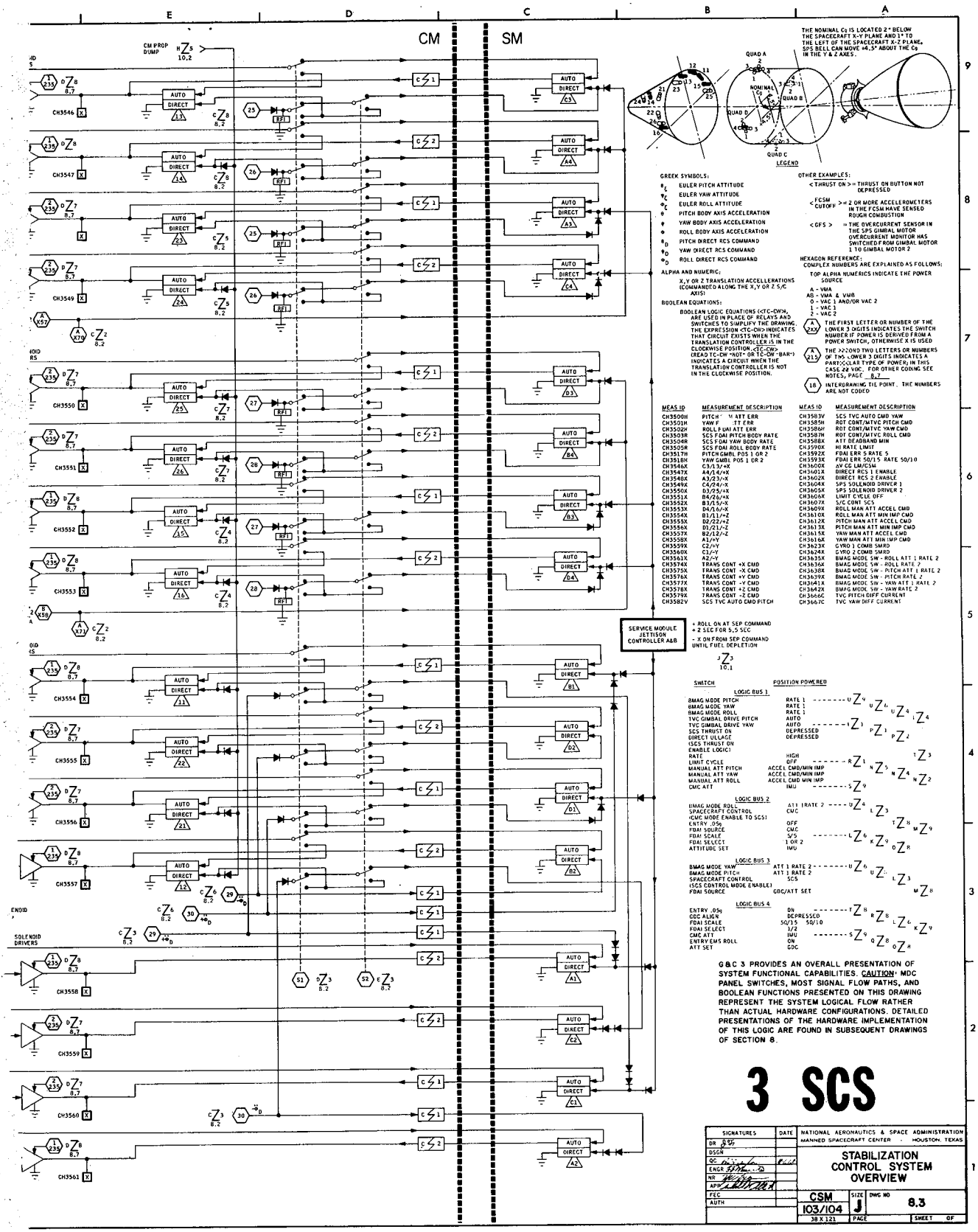
CODE	TYPE OF POWER
01	27.5 VDC
02	±20 VDC
03	10 VAC
04	2.2 KHz
05	25 VAC
06	±15 VDC
07	±14.5 VDC
08	400 Hz SPIN MOTOR POWER
09	26 VAC 400 Hz REFERENCE
10	14 VDC
11	13 VDC
12	-15 VDC
13	+20 VDC
14	±32 VDC
15	28 VDC
M	400 Hz 26 V BUS 1 SWITCH 3 OR 800 Hz 0 PHASE IMU
N	400 Hz 26 VAC BUS 2 SWITCH 3 OR 800 Hz 0 PHASE IMU
P	400 Hz 26 VAC BUS 2 SWITCH 3 OR 400 Hz 26 VAC BUS 1 SWITCH 6 OR 800 Hz 0 PHASE IMU
16	+X TRANSLATION
17	-X TRANSLATION
18	+Y TRANSLATION
19	-Y TRANSLATION
20	+Z TRANSLATION
21	-Z TRANSLATION
22	PITCH RATE COMMAND
23	YAW RATE COMMAND
24	ROLL RATE COMMAND
25	PITCH MIN IMP
26	YAW MIN IMP
27	ROLL MIN IMP
28	PITCH DIRECT
29	YAW DIRECT
30	ROLL DIRECT
31	SCS LOGIC BUS 1
32	SCS LOGIC BUS 2
33	SCS LOGIC BUS 3
34	SCS LOGIC BUS 4
35	-4 VDC
36	TRANSLATION CONTROL CLOCKWISE

CODE	TYPE OF POWER
37	SCS CONTROL MODE
38	RCS ERROR
39	GA1 AC RATE OR ATTITUDE ERROR
40	GA2 AC RATE
41	DC RATE
42	ENGINE ON WITH 1 SECOND DELAYED OFF
43	ENGINE ON/OFF 1 SECOND DELAY
44	MODE SELECTED SCS
45	PITCH GYRO UNCAGE
46	YAW GYRO UNCAGE
47	ROLL GYRO UNCAGE
48	SIG COND POWER ±15.0, -2.5 & -10 VDC
49	115 V 400 Hz PHASE A
50	MODE SELECTED CMC
51	PITCH AUTO CNTL DISABLE
52	YAW AUTO CNTL DISABLE
53	ROLL AUTO CNTL DISABLE
54	PITCH ACCEL CMD ENABLE
55	YAW ACCEL CMD ENABLE
56	ROLL ACCEL CMD ENABLE
57	DIRECT ULLAGE PITCH JETS
58	DIRECT ULLAGE YAW JETS
59	.05g OFF
60	GDC EULER
61	.05g ON
R	400/800 CPS OUT PHASE FDAI #1 RESOLVER SIG DEMOD
S	400/800 CPS OUT PHASE FDAI #2 RESOLVER SIG DEMOD
T	FDAI 1 & 2 PYR RATE DEMOD REF VOLTAGE
62	115 V 400 Hz
63	26 VAC <90°, 400 Hz REACTION
64	A/C ROLL ENGINE POWER CB15 & CB16 MDC 8
65	B/D ROLL REACTION ENGINE POWER CB17 & CB18 MDC 8
66	PITCH REACTION ENGINE POWER CB19 & CB20 MDC 8
67	YAW REACTION ENGINE POWER CB21 & CB22 MDC 8
68	REACTION ENGINE SOLENOID DRIVER ENABLE POWER CB74 & CB75 MDC 8 (AUTO RCS)
69	RCS LOGIC POWER FROM CB34 & CB35 PNL 229
70	SEQ A SPS THRUST ON LOGIC ENABLE AND SEP ULLAGE
71	SEQ B SPS THRUST ON LOGIC ENABLE AND SEP ULLAGE


BMAG MODE
PITCH
RATE 2
ATT 1
RATE 2
RATE 1
CH3638
CH3639
DC PITCH RATE 2
DC PITCH RATE 1
RATE CAGE ELECTRONICS
TORQUER AMPL
PRE AMPL
CAGE LOGIC
PITCH AC RATE OR ATT ERROR 1
PITCH GYRO ASSY NO 1
REQUIRES AC BUS 1 PHASE A, B & C
TEMP
SMRD
HEATER
AC PITCH RATE 2
MDC 1
521
PITCH GYRO ASSY NO 2
(PHYSICALLY & ELECTRICALLY IDENTICAL TO GA NO 1 PITCH EXCEPT THAT IT CANNOT BE UNCAGED)
REQUIRES AC BUS 2 PHASE A, B & C
ENTRY
.05G
OFF
DC PITCH RATE GA 1 OR 2
NOTE: THE GDC POSITION OF THIS SWITCH SHOULD NOT BE USED
CMC ATT IMU
GDC
GDC ALIGN
GDC BODY RATE TO EULER RATE TRANSFORMATION
MDC 1
S2
PITCH VOLTAGE TO FREQUENCY CONVERTER
DC YAW RATE GA 1 OR 2
DC ROLL RATE GA 1 OR 2
ENTRY STABILITY ROLL TRANSFORMATION
YAW VOLTAGE TO FREQUENCY CONVERTER
DC ROLL RATE 1
DC YAW RATE 1
ENTRY STABILITY ROLL TRANSFORMATION
ROLL VOLTAGE TO FREQUENCY CONVERTER
S37
S51
BMAG MODE
YAW
CH3641
CH3642
DC YAW RATE 2
DC YAW RATE 1
YAW GYRO ASSY NO 1
REQUIRES AC BUS 1 PHASE A, B&C
AC YAW RATE OR ATT ERROR 1
AC YAW RATE 2
MDC 1
522
YAW GYRO ASSY NO 2
(PHYSICALLY & ELECTRONICALLY IDENTICAL TO GA NO 1 YAW EXCEPT THAT IT CANNOT BE UNCAGED)
REQUIRES AC BUS 2 PHASE A, B&C
S51
AC PITCH, YAW AND ROLL ATT ERROR
AC PITCH, YAW AND ROLL RATE 1 OR 2
ATTI
ATTITUDE
BMAG MODE
ROLL
CH3635
CH3636
DC ROLL RATE 2
DC ROLL RATE 1
ROLL GYRO ASSY NO 1
REQUIRES AC BUS 1 PHASE A, B&C
AC ROLL RATE OR ATT ERROR 1
AC ROLL RATE 2
MDC 1
520
ROLL GYRO ASSY NO 2
(PHYSICALLY AND ELECTRICALLY) IDENTICAL TO GA NO 1 ROLL EXCEPT THAT IT CANNOT BE UNCAGED)
REQUIRES AC BUS 2 PHASE A, B&C
PITCH GIMBAL AND TRIM
PITCH ATTITUDE ERROR AMP
PITCH ATT ERROR
PITCH AUTO TVC INTEGRATOR
ENG IGN 1 SEC DELAY OFF
PROP FB
ENG IGN
INT FB
SCS TVC RATE CMD
LM OFF FILTER
LM ON FILTER
PITCH TVC INVERTER AMP
CH3582
PITCH MTVC CMD
CH3585
ΔV CG LM/CSM
CSM
MDC 1
S54
YAW ATTITUDE ERROR AMP
YAW ATT ERROR
YAW AUTO TVC INTEGRATOR
YAW TVC INVERTER AMP
YAW MTVC CMD
CH3586
YAW GIMBAL AND TRIM
PITCH PROP CNTL
YAW PROP CNTL
BMAG MODE SWITCHES: PITCH, YAW AND ROLL
GA 1 CAGE LOGIC SATISFIED WHEN:
RATE 2
CAGE GA 1 IN SELECTED AXIS DO NOT USE FOR CONTROLS & DISPLAYS
ATT 1 RATE 2
CAGE GA 1 IN SELECTED AXIS WHEN THE RHC BREAKOUT SWITCHES ARE CLOSED OR THE MANUAL ATTITUDE SWITCH IS IN ACCEL CMD OR MIN IMPULSE
RATE 1
CAGE GA 1 IN SELECTED AXIS AND USE FOR CONTROLS AND DISPLAYS
GA 1 GYROS ARE UNCAGED AT ALL OTHER TIMES
RATE HIGH
LOW
CH3590
DEADBAND MAX
MIN
CH3588
MAX
PITCH RATE
YAW RATE
ROLL ATT ERROR
ROLL RATE
PITCH RATE ERROR AMP
YAW RATE ERROR AMP
ROLL ATT ERROR AMP
ROLL RATE ERROR AMP
ENG IGN 1
ROLL PROP CNTL AMP
CH3587
YAW ATT ERROR
ROLL TO YAW COUPLING
.05g SWITCH ON
LIMIT CYCLE
SW AMP
+PITCH
-PITCH
+YAW
-YAW
+ROLL
-ROLL
PSEUDO RATE
MDC 1
S10
S11
S12


E REFERENCE SYSTEM
ND TVC CONTROL SYSTEM
EMS ROLL INDICATOR
ISS 28 V 1¢ 800 HZ
IMU INNER GIMBAL PITCH RESOLVER
GDC INNER GIMBAL PITCH RESOLVER
IMU MIDDLE GIMBAL YAW RESOLVER
GDC MIDDLE GIMBAL YAW RESOLVER
IMU OUTER GIMBAL ROLL RESOLVER
GDC OUTER GIMBAL ROLL RESOLVER
STEPPER MOTOR
ENTRY
FDAI
SOURCE
EULER ERROR TO BODY ATTITUDE ERROR CONVERSION
ISS CDU DAC OUTPUTS PITCH, YAW & ROLL
MANUAL ATTITUDE
PITCH GIMBAL ANGLE
PITCH AUTO OR MTVC CMD
PITCH MTVC CMD
PITCH RCS CMD
LV TANK PRESS
S-II FUEL/S-IVB OXID
S-IVB FUEL
SCS TVC
LV/SPS IND
SPS GIMBAL
YAW AUTO OR MTVC CMD
YAW MTVC CMD
YAW RCS CMD
ROLL RCS CMD
YAW GIMBAL ANGLE
AV THRUST
DIRECT ULLAGE
THRUST ON
ENG IGN
EMS ΔV RANGE
ΔV SET > 00000
ΔV SET ≤ 00000
RANGE
ΔV RANGE
14000.0
SPS READY TO CMC
TO SPS PROPELLANT - A CONTROL PILOT PREVALVE SOLENOIDS - B
SPS THRUST DIRECT ON
SPS PROPELLANT CONTROL PILOT VALVE SOLENOID "A"
SPS PROPELLANT CONTROL PILOT VALVE SOLENOID "B"
EMS THRUST ON LIGHT
SOLENOID DRIVER A
SOLENOID DRIVER B
FCSM CUTOFF
FROM CMC ENGINE IGNITION
SC CONT CMC
SPS A
SPS B
RESET/OVERRIDE
MINIMUM IMPULSE GENERATOR
RCS DAP PITCH AXIS
RCS DAP YAW AXIS
TVC ROLL DAP OR RCS DAP ROLL AXIS
TVC DAP PITCH AXIS
TVC DAP YAW AXIS
ACCEL CMD
RATE CMD
MIN IMP
TC-CW
SCALE
ERR
RATE
50/15
50/10

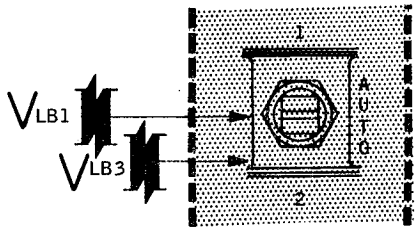

K
J
I
H
G
F
AUTO RCS ENABLE RELAY
SEQ A SYS
SEQ B SYS
AUTO RCS SELECT
PITCH
YAW
B/D ROLL
A/C ROLL
MNA
OFF
MNB
MDC 8
1 - FDAI - 2
ORB RATE
INRTL
ORDEAL
ORDEAL RESOLVER
CMC ATT SW GDC
EULER ATT DISPLAY ELECTRONICS FDAI NO 1
EULER ATT DISPLAY ELECTRONICS FDAI NO 2
ATT ERROR DISPLAY ELECTRONICS FDAI NO 1
ATT ERROR DISPLAY ELECTRONICS FDAI NO 2
RATE DISPLAY ELECTRONICS FDAI NO 1
RATE DISPLAY ELECTRONICS FDAI NO 2
CH3500
CH3501
CH3502
CH3503
CH3504
CH3505
ROLL
+ ATTITUDE ERROR-
+ ANGULAR VELOCITY-
PITCH AND YAW INDEX
ROLL INDEX
ATTITUDE ERROR
ANGULAR VELOCITY
ROLL TOTAL ATTITUDE SCALE
YAW
EULER ATTITUDE ON BALL
PITCH - θ = 014°
YAW - ψ = 034°
ROLL - Φ = 330°
NOTE:
ALL POLARITIES INDICATE VEHICLE DYNAMICS
DIRECT ULLAGE
SPS ENG IGN
MDP'S
DP'S
PITCH SERVO AMPL NO 1
PITCH SERVO AMPL NO 2
YAW SERVO AMPL NO 1
YAW SERVO AMPL NO 2
EXTEND CLUTCH
RETRACT CLUTCH
GIMBAL ACTUATOR
TACH
POS
SPS GIMBAL MOTORS
1 START
2 START
GIMBAL MOTOR START LOGIC AND FAIL SENSING (GFS)
TVC GIMBL DRIVE
GFS
TC-CW
AUTO
TVC SERVO NO 1 POWER
TVC SERVO NO 2 POWER


CM
SM
AUTO
DIRECT
RFI
CH3546
CH3547
CH3549
CH3550
CH3551
CH3552
CH3553
CH3554
CH3555
CH3556
CH3557
CH3558
CH3559
CH3560
CH3561
SOLENOID DRIVERS
SERVICE MODULE JETTISON CONTROLLER A&B
+ ROLL ON AT SEP COMMAND
+ Z SEC FOR 9.5 SCC
- X ON FROM SEP COMMAND UNTIL FUEL DEPLETION
QUAD A
QUAD B
QUAD C
QUAD D
NOMINAL
LEGEND
THE NOMINAL CG IS LOCATED 2" BELOW THE SPACECRAFT X-Y PLANE AND 1" TO THE LEFT OF THE SPACECRAFT X-Z PLANE. SPS BELL CAN MOVE ±4.5° ABOUT THE CG IN THE Y & Z AXES.
GREEK SYMBOLS:
EULER PITCH ATTITUDE
EULER YAW ATTITUDE
EULER ROLL ATTITUDE
PITCH BODY AXIS ACCELERATION
YAW BODY AXIS ACCELERATION
ROLL BODY AXIS ACCELERATION
PITCH DIRECT RCS COMMAND
YAW DIRECT RCS COMMAND
ROLL DIRECT RCS COMMAND
ALPHA AND NUMERIC:
X, Y OR Z TRANSLATION ACCELLERATIONS (COMMANDED ALONG THE X, Y OR Z S/C AXIS)
BOOLEAN EQUATIONS:
BOOLEAN LOGIC EQUATIONS (<TC-CW>) ARE USED IN PLACE OF RELAYS AND SWITCHES TO SIMPLIFY THE DRAWING. THE EXPRESSION <TC-CW> INDICATES THAT CIRCUIT EXISTS WHEN THE TRANSLATION CONTROLLER IS IN THE CLOCKWISE POSITION. <TC-CW> (READ TC-CW "NOT" OR TC-CW "BAR") INDICATES A CIRCUIT WHEN THE TRANSLATION CONTROLLER IS NOT IN THE CLOCKWISE POSITION.
OTHER EXAMPLES:
<THRUST ON> = THRUST ON BUTTON NOT DEPRESSED
<FCSM CUTOFF> = 2 OR MORE ACCELEROMETERS IN THE FCSM HAVE SENSED ROUGH COMBUSTION
<GFS> = THE OVERCURRENT SENSOR IN THE SPS GIMBAL MOTOR OVERCURRENT MONITOR HAS SWITCHED FROM GIMBAL MOTOR 1 TO GIMBAL MOTOR 2
HEXAGON REFERENCE:
COMPLEX NUMBERS ARE EXPLAINED AS FOLLOWS:
TOP ALPHA NUMERICS INDICATE THE POWER SOURCE
A - VMA
AB - VMA & VMB
O - VAC 1 AND/OR VAC 2
1 - VAC 1
2 - VAC 2
THE FIRST LETTER OR NUMBER OF THE LOWER 3 DGITS INDICATES THE SWITCH NUMBER IF POWER IS DERIVED FROM A POWER SWITCH, OTHERWISE X IS USED
THE >2ND TWO LETTERS OR NUMBERS OF THE LOWER 3 DGITS INDICATES A PARTICULAR TYPE OF POWER. IN THIS CASE, 28 VDC. FOR OTHER CODING SEE NOTES, PAGE 8.2
INTERGRAWING TIE POINT. THE NUMBERS ARE NOT CODED
MEAS ID | MEASUREMENT DESCRIPTION
CH3500H PITCH ATT ERR
CH3501H YAW ATT ERR
CH3502H ROLL FDAI ATT ERR
CH3503H SCS FDAI PITCH BODY RATE
CH3504H SCS FDAI YAW BODY RATE
CH3505H SCS FDAI ROLL BODY RATE
CH3517H PITCH GMBL POS 1 OR 2
CH3518H YAW GMBL POS 1 OR 2
CH3546X C3/13/+X
CH3547X A4/14/+X
CH3548X A3/23/-X
CH3549X C4/24/-X
CH3550X B3/25/+X
CH3551X B4/26/+X
CH3552X B1/15/-X
CH3553X D4/16/+X
CH3554X B1/11/+Z
CH3555X D2/22/+Z
CH3556X D1/21/-Z
CH3557X B2/12/-Z
CH3558X A1/+Y
CH3559X C2/+Y
CH3560X C1/-Y
CH3561X A2/-Y
CH3574X TRANS CONT +X CMD
CH3575X TRANS CONT -X CMD
CH3576X TRANS CONT +Y CMD
CH3577X TRANS CONT -Y CMD
CH3578X TRANS CONT +Z CMD
CH3579X TRANS CONT -Z CMD
CH3582V SCS TVC AUTO CMD PITCH
MEAS ID | MEASUREMENT DESCRIPTION
CH3583V SCS TVC AUTO CMD YAW
CH3585H ROT CONT/MTVC PITCH CMD
CH3586H ROT CONT/MTVC YAW CMD
CH3587H ROT CONT/MTVC ROLL CMD
CH3588X ATT DEADBAND MIN
CH3590X HI RATE LIMIT
CH3592X FDAI ERR 5 RATE 5
CH3593X FDAI ERR 50/15 RATE 50/10
CH3600X ΔV CG LAT/CSM
CH3601X DIRECT RCS 1 ENABLE
CH3602X DIRECT RCS 2 ENABLE
CH3604X SPS SOLENOID DRIVER 1
CH3605X SPS SOLENOID DRIVER 2
CH3606X LIMIT CYCLE OFF
CH3607X S/C CONT SCS
CH3609X ROLL MAN ATT ACCEL CMD
CH3610X ROLL MAN ATT MIN IMP CMD
CH3612X PITCH MAN ATT ACCEL CMD
CH3613X PITCH MAN ATT MIN IMP CMD
CH3615X YAW MAN ATT ACCEL CMD
CH3616X YAW MAN ATT MIN IMP CMD
CH3623X GYRO 1 COMB SMRD
CH3624X GYRO 2 COMB SMRD
CH3635X BMAG MODE SW - ROLL ATT 1 RATE 2
CH3636X BMAG MODE SW - ROLL RATE 2
CH3638X BMAG MODE SW - PITCH ATT 1 RATE 2
CH3639X BMAG MODE SW - PITCH RATE 2
CH3641X BMAG MODE SW - YAW ATT 1 RATE 2
CH3642X BMAG MODE SW - YAW RATE 2
CH3666C TVC PITCH DIFF CURRENT
CH3667C TVC YAW DIFF CURRENT
SWITCH | POSITION POWERED
LOGIC BUS 1
BMAG MODE PITCH — RATE 1
BMAG MODE YAW — RATE 1
BMAG MODE ROLL — RATE 1
TVC GIMBAL DRIVE PITCH — AUTO
TVC GIMBAL DRIVE YAW — AUTO
SCS THRUST ON — DEPRESSED
DIRECT ULLAGE — DEPRESSED
ISCS THRUST ON
ENABLE LOGIC
RATE — HIGH
LIMIT CYCLE — OFF
MANUAL ATT PITCH — ACCEL CMD/MIN IMP
MANUAL ATT YAW — ACCEL CMD/MIN IMP
MANUAL ATT ROLL — ACCEL CMD MIN IMP
CMC ATT — IMU
LOGIC BUS 2
BMAG MODE ROLL — ATT 1 RATE 2
SPACECRAFT CONTROL — CMC
ICMC MODE ENABLE TO SCS1
ENTRY .05g — OFF
FDAI SOURCE — CMC
FDAI SCALE — 5/5
FDAI SELECT — 1 OR 2
ATTITUDE SET — IMU
LOGIC BUS 3
BMAG MODE YAW — ATT 1 RATE 2
BMAG MODE PITCH — ATT 1 RATE 2
SPACECRAFT CONTROL — SCS
(SCS CONTROL MODE ENABLE)
FDAI SOURCE — GDC/ATT SET
LOGIC BUS 4
ENTRY .05g — ON
GDC ALIGN — DEPRESSED
FDAI SCALE — 50/15 50/10
FDAI SELECT — 1/2
CMC ATT — IMU
ENTRY/EMS ROLL — ON
ATT SET — GDC
G&C 3 PROVIDES AN OVERALL PRESENTATION OF SYSTEM FUNCTIONAL CAPABILITIES. CAUTION: MDC PANEL SWITCHES, MOST SIGNAL FLOW PATHS, AND BOOLEAN FUNCTIONS PRESENTED ON THIS DRAWING REPRESENT THE SYSTEM LOGICAL FLOW RATHER THAN ACTUAL HARDWARE CONFIGURATIONS. DETAILED PRESENTATIONS OF THE HARDWARE IMPLEMENTATION OF THIS LOGIC ARE FOUND IN SUBSEQUENT DRAWINGS OF SECTION 8.
3 SCS
SIGNATURES
DR
DSGN
QC
ENGR
NR
APP
FEC
AUTH
DATE
NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS
STABILIZATION CONTROL SYSTEM OVERVIEW
CSM 103/104
SIZE J
DWG NO 8.3
38 X 121
PAGE
SHEET OF

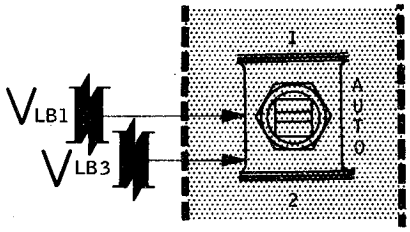
SECTION 8

IS

1. DWG 8.3 J Z4



2. DWG 8.3 J Z2



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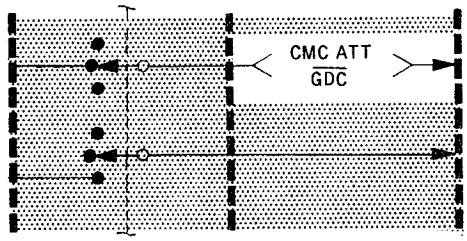

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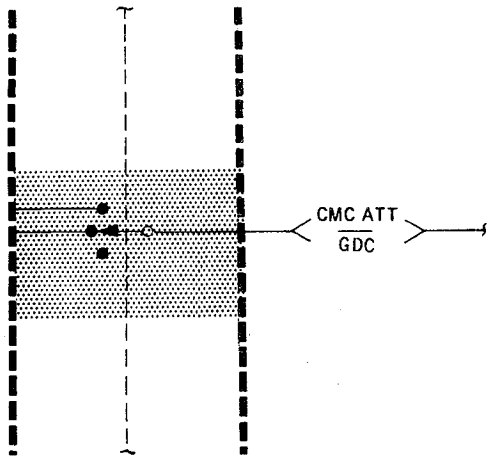
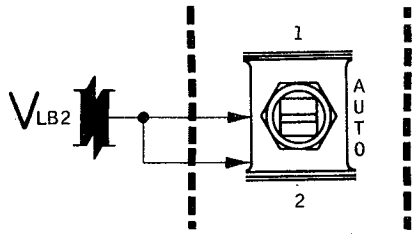
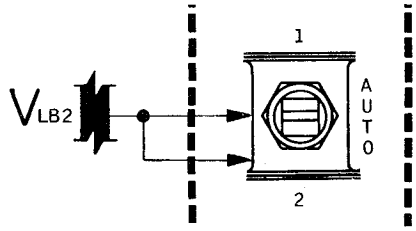
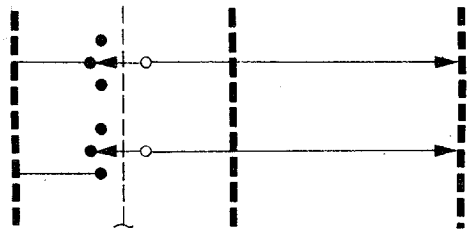
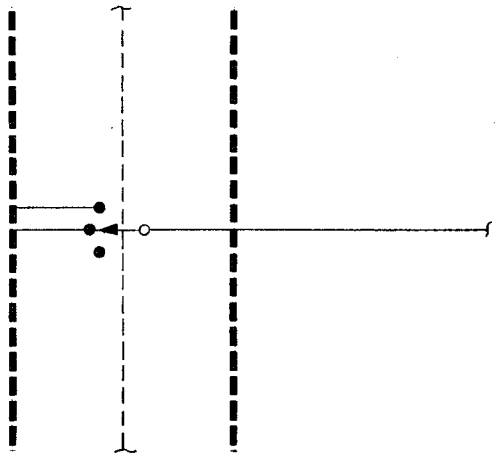


WAS





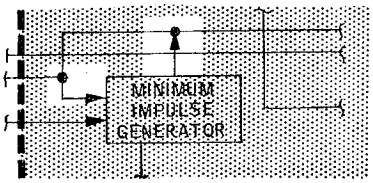




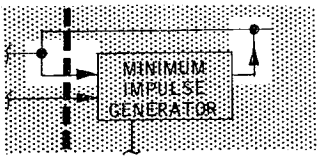
SECTION 8

IS

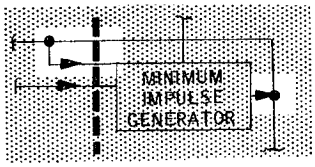
5. DWG 8.3 M Z 5



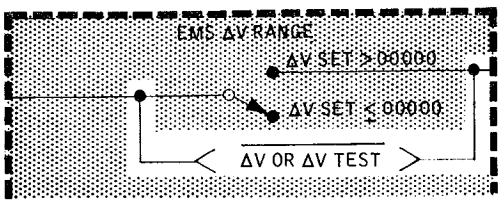
6. DWG 8.3 M Z 4



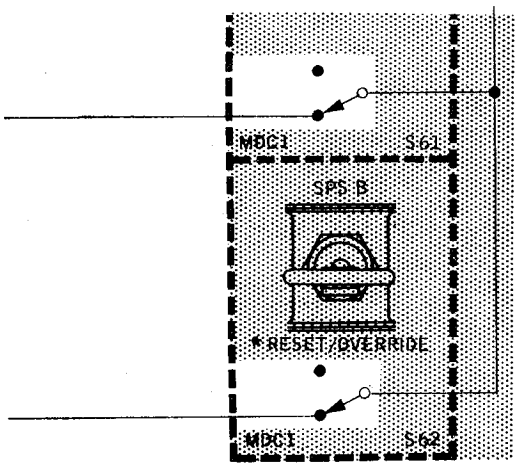
7. DWG 8.3 M Z 2



8. DWG 8.3 O Z 1



9. DWG 8.3 L Z 1



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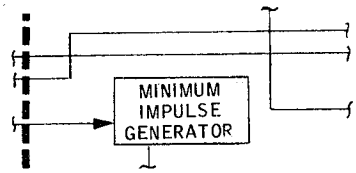
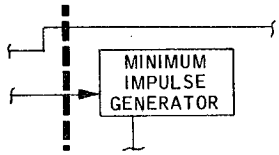
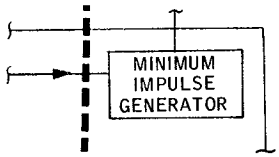
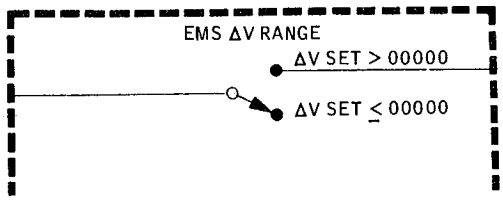
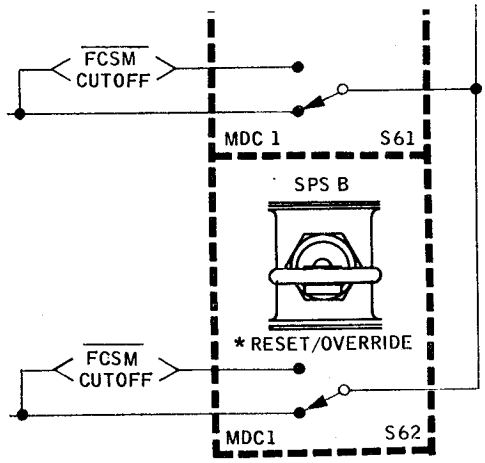






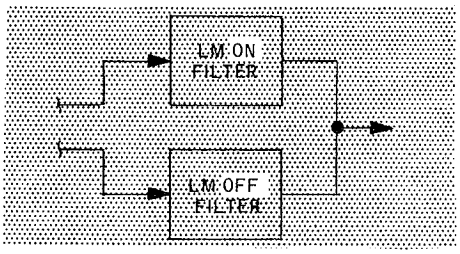




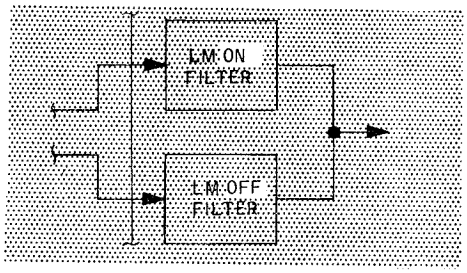
SECTION 8

IS

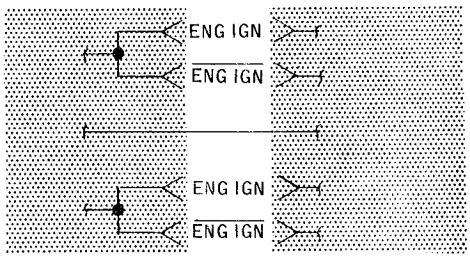
10. DWG 8.3 R Z 4



11. DWG 8.3 R Z 3



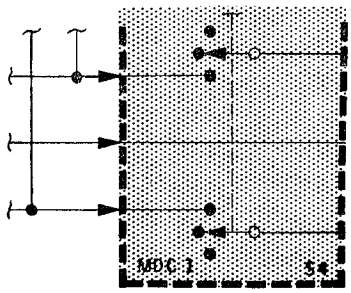
12. DWG 8.3 U Z 1



13. DWG 8.3 S Z 9

V_{LB1}

14. DWG 8.3 N Z 6



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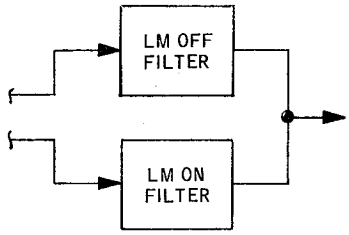
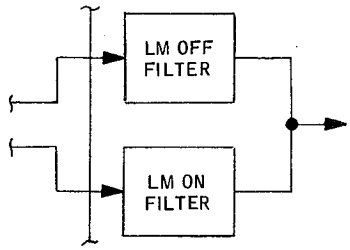
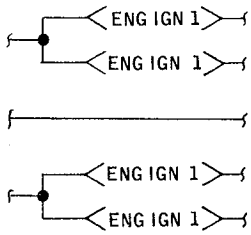
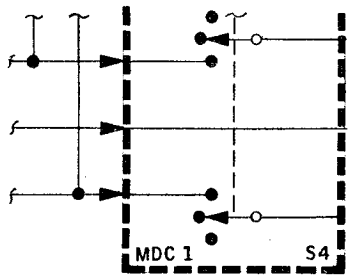






V_{LB2}



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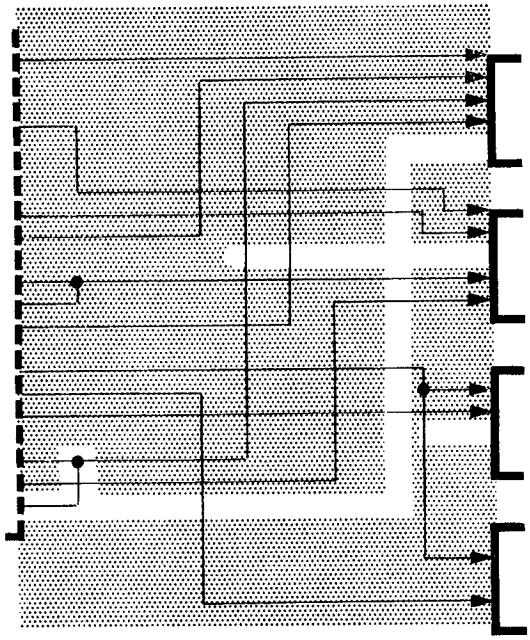
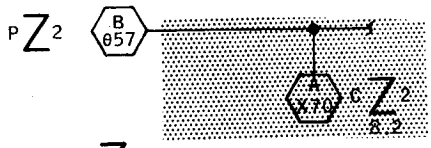
IS

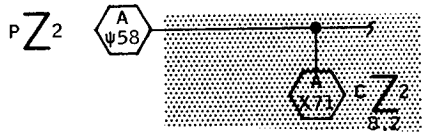
15. DWG 8.3 K Z 6



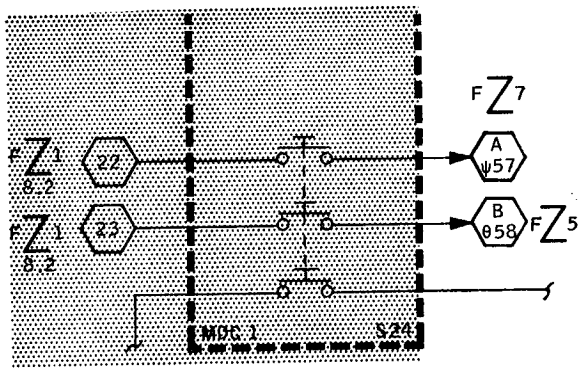
16. DWG 8.3 F Z 7



17. DWG 8.3 F Z 5



18. DWG 8.3 Q Z 2



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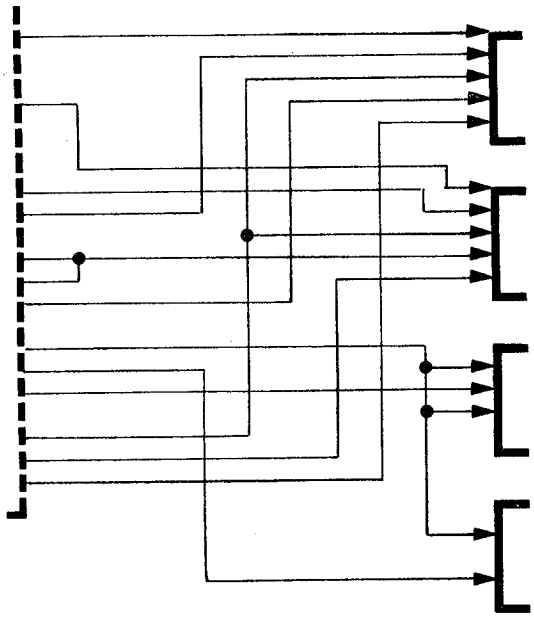

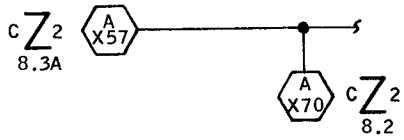

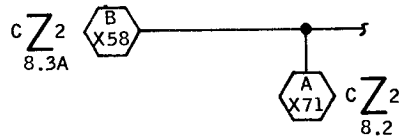

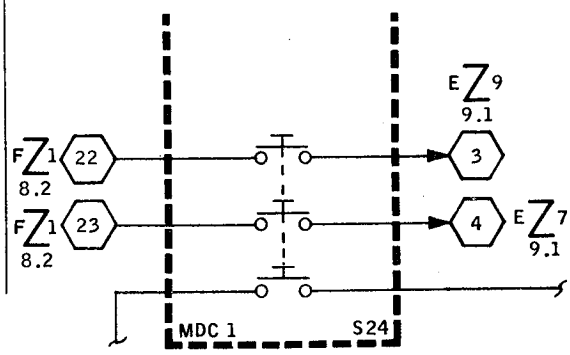

TABLE 8-I. - S/C 103 CMC INPUT/OUTPUT CHANNELS ON TELEMETRY

BITS	OUTPUT				INPUT			
	CHANNEL							
	11 WD91a	12 WD91b	13 WD92a	14 WD92b	30 WD93a	31 WD93b	32 WD94a	33 WD94b
1	ISS WARN	OCDU ZERO			S4 ULLAGE	+P RHC	+P MIC	
2	COMP ACTV	OPT EC EN			RCS XFER	-P RHC	-P MIC	
3	UPL ACTV				SPS READY	+Y RHC	+Y MIC	
4	TEMP CAUT	COAR ALGN			S4 SP/ABT	-Y RHC	-Y MIC	
5	KEY REL	ICDU ZERO			CMC L/O	+R RHC	+R MIC	
6	FLASH	IMU EC EN	BL INLINK	GY ENABLE		-R RHC	-R MIC	
7	OPR ERR		DN WD ORD	GY SEL B*	OCDU FAIL	+X TRANS		
8		TVC ENABLE		GY SEL A*		-X TRANS		
9	TST CONN	IVB TK/EN		GY SIGN- *	IMU OPER	+Y TRANS		
10	CAUT REST	ZERO OPT	TST ALARM	GY ACT	SAT TAKO	-Y TRANS		UP TM BLK
11		DIS O DAC	EN STBY	DR CDU S	IMU CAGE	+Z TRANS	LM ATTACH	UPL FAST
12			RST T 31A	DR CDU T	ICDU FAIL	-Z TRANS		DNL FAST
13	ENG ON	S-IVB INJ	RST T 31B	DR CDU Z	IMU FAIL	FREE/AUTO		PIPA FAIL
14		S-IVB CO	RST T 32	DR CDU Y	ISS TN ON	HOLD/AUTO	PROCEED	CMC WARN
15		EN T6 RUPT	EN T6 RUPT	DR CDU X	IMU TEMP	A/P CONT		OSC ALARM

* GYRO SELECT	
AB	GYRO
00	-
01	X
10	Y
11	Z

TABLE 8-II.- CSM 103 ALARM CODES

CSM 104

ALARM CODE (OCTAL)	PROGRAM ALARM IS ON ACTION REQUIRED FOR DISPLAY	DESCRIPTION
110	V05N09 FOR DISPLAY	MARK REJECT WITH NO EFFECT (NO MARK IS REJECTED, EITHER PREVIOUS MARKS HAVE BEEN ACCEPTED OR NONE RECEIVED).
112	V05N09 FOR DISPLAY	MARK NOT BEING ACCEPTED.
113	V05N09 FOR DISPLAY	PROGRAM INTERRUPT #6 HAS OCCURRED WITH CHANNEL 16 = 0. (CHANNEL 16 MONITORS MARK, MARK REJECT AND NAV DSKY.)
114	V05N09 FOR DISPLAY	OPTICS MARK RECEIVED WITH ALL REQUESTED MARKS ALREADY PROCESSED.
115	V05N09 FOR DISPLAY	OPTICS MODE SWITCH NOT IN COMPUTER POSITION WITH OPTICS DRIVE REQUEST MADE. OPERATOR ERROR LAMP ON.
116	V05N09 FOR DISPLAY	OPTICS SWITCH ALTERED BEFORE 15 SEC ZERO TIME ELAPSED.
117	V05N09 FOR DISPLAY	OPTICS NOT AVAILABLE FOR DRIVING WHEN DRIVE REQUEST RECEIVED.
120	V05N09 FOR DISPLAY	OPTICS DRIVE REQUEST WITH OPTICS NOT PREVIOUSLY ZEROED.
121	V05N09 FOR DISPLAY	IMU CDU CHANGE EXCESSIVE AFTER A MARK.
122	V05N09 FOR DISPLAY	OPTICS MARK RECEIVED WITH MARK SYSTEM NOT IN USE.
124	AUTO DISPLAY V05N09 FLASHING	PROGRAM 17 TPI SEARCH - NO SAFE PERICENTER IN THIS SECTOR.
205	V05N09 FOR DISPLAY	ACCELEROMETER SATURATED DURING SERVICER ROUTINE MONITOR (6400 PULSES IN 2 SEC).
206	V05N09 FOR DISPLAY	REQUEST FOR IMU CDU ZERO REJECTED SINCE IMU IN COARSE ALIGN DUE TO GIMBAL LOCK.
207	V05N09 FOR DISPLAY	ISS TURN ON REQUEST NOT PRESENT FOR THE REQUIRED 90 SEC PERIOD.
210	V05N09 FOR DISPLAY	IMU NOT OPERATING.
211	V05N09 FOR DISPLAY	EXCESSIVE ANGLE ERROR BETWEEN DESIRED AND ACTUAL CDU AFTER COARSE ALIGN COMPLETED (ERROR > 2°).
212	V05N09 FOR DISPLAY	PIPA FAIL HAS OCCURRED WITH PIPA'S NOT IN USE.
213	V05N09 FOR DISPLAY	ISS TURN ON REQUESTED WITH IMU OPERATE SIGNAL NOT PRESENT.

TABLE 8-II.- CSM 103 ALARM CODES - CONTINUED

CSM 104

ALARM CODE (OCTAL)	PROGRAM ALARM IS ON ACTION REQUIRED FOR DISPLAY	DESCRIPTION
214	V05N09 FOR DISPLAY	PROGRAM IS USING THE IMU WHEN THE IMU IS OFF.
215	AUTO DISPLAY V05N09 FLASHING	PREFERRED IMU ORIENTATION SELECTED BUT NOT AVAILABLE.
217	V05N09 FOR DISPLAY	ERROR RETURN FROM STALL ROUTINES.
220	V05N09 FOR DISPLAY	REFSMMAT (REFERENCE STABLE MEMBER MATRIX) IS BAD.
401	V05N09 FOR DISPLAY	COMPUTED MIDDLE GIMBAL ANGLE EXCEEDS 60° OR DESIRED FINAL MIDDLE GIMBAL ANGLE EXCEEDS 59.5° FOR AN ATTITUDE MANEUVER.
404	AUTO DISPLAY V05N09 FLASHING	NOT TRACKING LM AND TARGET IS OUTSIDE THE FIELD OF VIEW (TRUNNION ANGLE > 90°).
405	AUTO DISPLAY V05N09 FLASHING	TWO STARS NOT AVAILABLE.
406	V05N09 FOR DISPLAY	REND NAVIGATION NOT OPERATING.
407	V05N09 FOR DISPLAY	AUTO OPTICS REQUEST TRUNNION ANGLE > 50°.
421	V05N09 FOR DISPLAY	OVERFLOW IN THE ORBITAL INTEGRATION PACKAGE (W-MATRIX) HAS OCCURRED.
605	AUTO DISPLAY V05N09 FLASHING	NUMBER OF ITERATIONS EXCEEDS LOOP MAXIMUM.
611	AUTO DISPLAY V05N09 FLASHING	NO T_{IG} FOR GIVEN ELEVATION ANGLE.
612	AUTO DISPLAY V05N09 FLASHING	STATE VECTOR IN WRONG SPHERE OF INFLUENCE.
613	AUTO DISPLAY V05N09 FLASHING	REENTRY ANGLE OUT OF LIMITS.
1102	V05N09 FOR DISPLAY	FAILURE IN COMPUTER SELF TEST.
1103	RESTART ON V05N09 FOR DISPLAY	ILLEGAL STEP (UNUSED CCS BRANCH) HAS BEEN EXECUTED IN COMPUTER PROGRAM.
1104	RESTART ON V05N09 FOR DISPLAY	ANOTHER JOB USING THE JOB DELAY ROUTINE.
1105	V05N09 FOR DISPLAY	DOWNLINK RATE IS TOO FAST.
1106	V05N09 FOR DISPLAY	UPLINK RATE IS TOO FAST.
1107	V05N09 FOR DISPLAY	RESTART PHASE TABLE ENTRIES DISAGREE. ASSUME ERASABLE MEMORY IS DESTROYED.

TABLE 8-II.- CSM 103 ALARM CODES - CONCLUDED

CSM 104

ALARM CODE (OCTAL)	PROGRAM ALARM IS ON ACTION REQUIRED FOR DISPLAY	DESCRIPTION
1201	RESTART ON V05N09 FOR DISPLAY	EXECUTIVE OVERFLOW - NO VAC AREAS AVAILABLE.
1202	RESTART ON V05N09 FOR DISPLAY	EXECUTIVE OVERFLOW - NO CORE SETS AVAILABLE.
1203	RESTART ON V05N09	NEW TASK CANNOT BE SUCCESSFULLY INSERTED INTO WAITLIST.
1206	RESTART ON V05N09	DISPLAY SYSTEM ADDRESS BUFFERS ARE FULL, HENCE ANOTHER JOB CANNOT BE ACCOMPLISHED.
1207	RESTART ON V05N09	NO VAC AREAS AVAILABLE FOR SEXTANT MARKS.
1210	RESTART ON V05N09	TWO PROGRAMS TRYING TO USE A PARTICULAR 'STALL' ROUTINE AT THE SAME TIME.
1211	RESTART ON V05N09	OPTICS USE NOT ALLOWED WITH EXTENDED VERB BEING PERFORMED.
1301	RESTART ON V05N09	ARC SINE OR ARC COSINE ARGUMENT TOO BIG.
1302	RESTART ON V05N09	SQUARE ROOT CALLED WITH NEGATIVE ARGUMENT.
1407	V05N09 FOR DISPLAY	VG INCREASING - THRUST POINTING IN WRONG DIRECTION.
1410	V05N09 FOR DISPLAY	THRUST TOO LOW FOR CROSS PRODUCT STEERING.
1426	AUTO DISPLAY V05N09 FLASHING	IMU ORIENTATION UNSATISFACTORY FOR ENTRY.
1427	AUTO DISPLAY V05N09 FLASHING	IMU ORIENTATION REVERSED FOR ENTRY.
1501	RESTART ON V05N09 FOR DISPLAY	DISPLAY SYSTEM ALARM.
1502	RESTART ON V05N09 FOR DISPLAY	ILLEGAL REQUEST FOR FLASHING DISPLAY.
1520	V05N09 FOR DISPLAY	MAJOR MODE CHANGE (V37) CANNOT BE ACCEPTED.
1600	V05N09 FOR DISPLAY	OVERFLOW DURING COMPUTATION OF GYRO DRIFT HAS OCCURRED.
1601	V05N09 FOR DISPLAY	BAD IMU TORQUE.
1602	V05N09 FOR DISPLAY	BAD OPTICS DURING OPTICAL VERIFICATION.
1703	V05N09 FOR DISPLAY	INSUFFICIENT TIME FOR INTEGRATION TIG WAS SLIPPED.

COAST AND ALIGN

TRANSMITTED IN PROGRAMS 00,01,02,03,06,07,11,51,52,53,54

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
1A	LIST ID	$(77777)_8$ INDICATED COAST AND ALIGN LIST BEING TRANSMITTED
1B	SYNC BITS	$(77340)_8$ INDICATES DATA TO FOLLOW
2A 2B	R_X X COMPONENT OF VEHICLE POSITION VECTOR	CSM VEHICLE STATE VECTOR AND TIME
3A 3B	R_Y Y COMPONENT OF VEHICLE POSITION VECTOR	
4A 4B	R_Z Z COMPONENT OF VEHICLE POSITION VECTOR	
5A 5B	V_X X COMPONENT OF VEHICLE VELOCITY VECTOR	
6A 6B	V_Y Y COMPONENT OF VEHICLE VELOCITY VECTOR	
7A 7B	V_Z Z COMPONENT OF VEHICLE VELOCITY VECTOR	
8A 8B	T_{SV} TIME TAG FOR $\bar{R}$ AND $\bar{V}$	
9A 9B 10A	CDUX CDUY CDUZ	X, Y, AND Z CDU INPUT COUNTERS. READ THE IMU COUNTERS ZEROED DURING ZERO ENCODE MODE (IMODES 33 BIT 5 = 1)
10B	CDUT	TRUNNION CDU INPUT COUNTER
11A 11B	$ADOT_X$	MEASURED BODY RATES ABOUT THE X, Y, AND Z CONTROL AXES ANY TIME THE RCS DAP IS ON
12A 12B	$ADOT_Y$	
13A 13B	$ADOT_Z$	
14A 14B 15A	AK AK1 AK2	VEHICLE ATTITUDE ERRORS (RPY) SENT TO FDAI. DURING P11, THE VALUE IS DIVIDED BY 4 SO THAT MAXIMUM ERROR IS 4 X 16-2/3 DEG. DURING RCS DAP OPERATION EITHER TOTAL ATTITUDE OR DAP FOLLOWING ERROR IS DISPLAYED (DETERMINED BY FLAGWORD 0 BIT 9).
15B	RCSFLAGS	

BIT	SET	RESET
15	NOT USED	
14	RATE FILTER NOT INITIALIZED	RATE FILTER INITIALIZED
13	ROLL RATE DAMPING REQUIRED	
12	PITCH RATE DAMPING REQUIRED	
11	YAW RATE DAMPING REQUIRED	

TRANSMITTED IN PROGRAMS 00,01,02,03,06,07,11,51,52,53,54

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
15B	RCSFLAGS	BIT 10: SET: -ROLL RHC INPUT; RESET:
		BIT 9: SET: +ROLL RHC INPUT; RESET:
		BIT 8: SET: -YAW RHC INPUT; RESET:
		BIT 7: SET: +YAW RHC INPUT; RESET:
		BIT 6: SET: -PITCH RHC INPUT; RESET:
		BIT 5: SET: +PITCH RHC INPUT; RESET:
		BIT 4: SET: COMPUTE AK'S (ATTITUDE ERRORS); RESET: PERFORM NEEDLER TO DISPLAY AK'S
		BIT 3: 0 } 3RD PASS THRU NEEDLER; 0 } 2ND PASS THRU NEEDLER; 1 } INITIAL PASS THRU NEEDLER
		BIT 2: 0 } 3RD PASS THRU NEEDLER; 1 } 2ND PASS THRU NEEDLER; 1 } INITIAL PASS THRU NEEDLER
		BIT 1: SET: ; RESET: INITIALIZE T_6 PROGRAM
16A 16B 17A	$THETAD_X$ $THETAD_Y$ $THETAD_Z$	X, Y, AND Z REFERENCE CDU ANGLES FOR THE ATTITUDE HOLD ROUTINE. INTERMEDIATE DESIRED CDU ANGLES FOR AUTO MANEUVER ROUTINE.
17B	$DELCDU_X$	MOST SIGNIFICANT HALF OF X INCREMENTAL GIMBAL ANGLE USED IN AUTOMATIC MANEUVERS
18A 18B	TIG	TIME OF IGNITION
19A	BESTI	FIRST STAR NUMBER MULTIPLIED BY 6
19B	BESTJ	SECOND STAR NUMBER MULTIPLIED BY 6
20A	MARKDOWN (TIME2)	MARK DATA FOR THE FIRST MARK
20B	MARKDOWN+1 (TIME1)	
21A	MARKDOWN+2 (CDUY)	
21B	MARKDOWN+3 (CDUS)	
22A	MARKDOWN+4 (CDUZ)	
22B	MARKDOWN+5 (CDUT)	
23A	MARKDOWN+6 (CDUX)	
23B	BDT	EFFECT OF RATE OF CHANGE OF REQUIRED VELOCITY AND GRAVITY DURING DT UPON VELOCITY-TO-BE GAINED
24A	MARK2DWN (TIME2)	MARK DATA FOR THE SECOND MARK
24B	MARK2DWN+1 (TIME1)	
25A	MARK2DWN+2 (CDUY)	
25B	MARK2DWN+3 (CDUS)	
26A	MARK2DWN+4 (CDUZ)	
26B	MARK2DWN+5 (CDUT)	
27A	MARK2DWN+6 (CDUX)	
27B	UNITV+2	MOST SIGNIFICANT HALF OF THE Y COMPONENT OF A UNITIZED VELOCITY USED DURING REENTRY

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
28A 28B	HAPO	ALTITUDE OF APOGEE		
29A 29B	HPER	ALTITUDE OF PERIGEE		
30A 30B	RSP-RREC	DOWNRANGE RECOVERY RANGE ERROR		
31A 31B	$VGTIG_X$	X, Y, AND Z COMPONENTS OF VELOCITY TO BE GAINED. NOT USED IN COAST AND ALIGN PROGRAMS		
32A 32B	$VGTIG_Y$			
33A 33B	$VGTIG_Z$			
34A 34B	X_X	REFSMMAT		
35A 35B	X_Y			
36A 36B	X_Z			
37A 37B	Y_X			
38A 38B	Y_Y			
39A 39B	Y_Z			
40A	FLAGWORD 0	BIT	SET	RESET
	CPHIFLAG	15	OUTPUT OF CALCGA IS CPHIX	OUTPUT OF CALCGA IS THETAD
	JSWITCH	14	INTEGRATION OF W MATRIX	INTEGRATION OF STATE VECTOR
	MIDFLAG	13	INTEGRATION WITH SOLAR PERTURBATIONS	INTEGRATION WITHOUT SOLAR PERTURBATIONS
	MOONFLAG	12	MOON IS SPHERE OF INFLUENCE	EARTH IS SPHERE OF INFLUENCE
	NORFHOR	11	NOT USED IN COAST AND ALIGN LIST	
	ZMEASURE	10	NOT USED IN COAST AND ALIGN LIST	
	NEEDLFLG	9	TOTAL ALTITUDE ERROR DISPLAYED	A/P FOLLOWING ERROR DISPLAYED
	IMUSE	8	IMU IN USE	IMU NOT IN USE
	RNDVZFLG	7	NOT USED IN COAST AND ALIGN LIST	
	R53FLAG	6	V51 INITIATED	V51 NOT INITIATED
	F2RTE	5	NOT USED IN COAST AND ALIGN LIST	
	TRUNFLAG	4	DRIVING OF TRUNNION ALLOWED	DRIVING OF TRUNNION NOT ALLOWED
	FREEFLAG	3	USED TO CONTROL INTERNAL SUBROUTINE PERFORMANCE	
	B29FLAG	2	NOT USED	
	KFLAG	1	NOT USED IN COAST AND ALIGN LIST	
40B	FLAGWORD 1	BIT	SET	RESET
	NJETSFLG	15	TWO JET RCS BURN	FOUR JET RCS BURN
	STIKFLAG	14	RHC CONTROL OF RCS	CMC CONTROL OF RCS

TRANSMITTED IN PROGRAMS 00,01,02,03,06,07,11,51,52,53,54

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
40B	FLAGWORD 1	BIT	SET	RESET
	ERADFLAG	13	COMPUTE REARTH FISCHER ELLIPSOID	USE CONSTANT REARTH PAD RADIUS
		12	NOT USED	
	ENG2FLAG	11	NOT USED IN COAST AND ALIGN LIST	
	TARG1FLG	10	NOT USED IN COAST AND ALIGN LIST	
	R23FLG	9	NOT USED IN COAST AND ALIGN LIST	
	VEHUPFLG	8	CMS STATE VECTOR BEING UPDATED	LM STATE VECTOR BEING UPDATED
	UPDATFLG	7	NOT USED IN COAST AND ALIGN LIST	
	IDLEFAIL	6	NOT USED IN COAST AND ALIGN LIST	
	TRACKFLG	5	NOT USED IN COAST AND ALIGN LIST	
		4	NOT USED	
	SLOPESW	3	NOT USED IN COAST AND ALIGN LIST	
		2	NOT USED IN COAST AND ALIGN LIST	
	AVEGFLAG	1	AVERAGE G (SERVICER) TO CONTINUE	AVERAGE G (SERVICER) TO CEASE
41A	FLAGWORD 2	BIT	SET	RESET
	DRIFTFLG	15	T3RUPT CALLS GYRO COMPENSATION	T3RUPT DOES NO GYRO COMPENSATION
	R21MARK	14	NOT USED IN COAST AND ALIGN LIST	
	22DSPFLG	13	NOT USED IN COAST AND ALIGN LIST	
		12	NOT USED	
	STERRSW	11	NOT USED IN COAST AND ALIGN LIST	
	CYCLESW	10	NOT USED IN COAST AND ALIGN LIST	
	IMPULSW	9	NOT USED IN COAST AND ALIGN LIST	
	XDELVFLG	8	NOT USED IN COAST AND ALIGN LIST	
	ETPIFLAG, FIRSTFLG OPTNSW	7	NOT USED IN COAST AND ALIGN LIST	
	FINALFLG	6	NOT USED IN COAST AND ALIGN LIST	
	AVFLAG	5	NOT USED IN COAST AND ALIGN LIST	
	PFRATFLG	4	PREFERRED ATTITUDE COMPUTED	PREFERRED ATTITUDE NOT COMPUTED
	CALCMAN3	3	NO GIMBAL LOCK AVOIDANCE REQUIRED	GIMBAL LOCK AVOIDANCE REQUIRED
	CALCMAN2	2	PERFORM MANEUVER STARTING PROCEDURE	BYPASS STARTING PROCEDURE
	NODOFLAG	1	V37 NOT PERMITTED	V37 PERMITTED
41B	FLAGWORD 3	BIT	SET	RESET
		15	NOT USED	
	GLOKFAIL	14	GIMBAL LOCK HAS OCCURRED	NOT IN GIMBAL LOCK
	REFSMFLG	13	REFSMMAT GOOD	REFSMMAT NO GOOD
	LUNAFLAG	12	LUNAR LAT-LONG	EARTH LAT-LONG
	P22MKFLG	11	NOT USED IN COAST AND ALIGN LIST	
	VFLAG	10	LESS THAN TWO STARS IN FIELD OF VIEW	TWO STARS IN FIELD OF VIEW
	ONMONFLG	9	NOT USED IN COAST AND ALIGN LIST	
	PRECIFLG	8	CSMPREC OR LEMPREC CALLED	INTEGRV OR INTEGRVS CALLED
	CULTFLAG	7	STAR OCCULTED	STAR NOT OCCULTED
	ORBWFLAG	6	W MATRIX VALID FOR ORBITAL INTEGRATION	W MATRIX INVALID FOR ORBITAL INTEGRATION
	STATEFLG	5	PERMANENT STATE VECTOR UPDATED	PERMANENT STATE VECTOR NOT UPDATED

TRANSMITTED IN PROGRAMS 00,01,02,03,06,07,11,51,52,53,54

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
		BIT	SET	RESET
41B	FLAGWORD 3			
	INTYPFLG	4	CONIC INTEGRATION	ENCKE INTEGRATION
	VINTFLAG	3	CSM STATE VECTOR BEING INTEGRATED	LM STATE VECTOR BEING INTEGRATED
	D60R9FLG	2	DIMENSION OF W IS 9 FOR INTEGRATION	DIMENSION OF W IS 6 FOR INTEGRATION
	DIMOFLAG	1	W MATRIX IS TO BE USED	W MATRIX IS NOT TO USED
42A	FLAGWORD 4	BIT	SET	RESET
	MRKIDFLG	15	MARK DISPLAY IN ENDIDLE	NO MARK DISPLAY IN ENDIDLE
	PRIODFLG	14	PRIORITY DISPLAY IN ENDIDLE	NO PRIORITY DISPLAY IN ENDIDLE
	NEMIDFLG	13	NORMAL DISPLAY IN ENDIDLE	NO NORMAL DISPLAY IN ENDIDLE
	PDSPFLAG	12	CAN NOT INTERRUPT PRIORITY DISPLAY	
	MWAITFLG	11	HIGHER PRIORITY DISPLAY OPERATING WHEN MARK DISPLAY INITIATED	NO HIGHER PRIORITY DISPLAY OPERATING WHEN MARK DISPLAY INITIATED
	NWAITFLG	10	HIGHER PRIORITY DISPLAY OPERATING WHEN NORMAL DISPLAY INITIATED	NO HIGHER PRIORITY DISPLAY OPERATING WHEN NORMAL DISPLAY INITIATED
	MRKNVFLG	9	ASTRONAUT USING KEYBOARD WHEN MARK DISPLAY INITIATED	ASTRONAUT NOT USING KEYBOARD WHEN MARK DISPLAY INITIATED
	NRMNVFLG	8	ASTRONAUT USING KEYBOARD WHEN NORMAL DISPLAY INITIATED	ASTRONAUT NOT USING KEYBOARD WHEN NORMAL DISPLAY INITIATED
	PRONVFLG	7	ASTRONAUT USING KEYBOARD WHEN PRIORITY DISPLAY INITIATED	ASTRONAUT NOT USING KEYBOARD WHEN PRIORITY DISPLAY INITIATED
	PINBRFLG	6	ASTRONAUT HAS INTERFERED WITH EXISTING DISPLAY	ASTRONAUT HAS NOT INTERFERED WITH EXISTING DISPLAY
	MRUPTFLG	5	MARK DISPLAY INTERRUPTED BY PRIORITY DISPLAY	MARK DISPLAY NOT INTERRUPTED BY PRIORITY DISPLAY
	NRUPTFLG	4	NORMAL DISPLAY INTERRUPTED BY PRIORITY OR MARK DISPLAY	NORMAL DISPLAY NOT INTERRUPTED BY PRIORITY OR MARK DISPLAY
	MKOVFLAG	3	MARK DISPLAY OVER NORMAL	NO MARK DISPLAY OVER NORMAL
		2	NOT USED	
	XDSPFLAG	1	MARK DISPLAY NOT TO BE INTERRUPTED	
42B	FLAGWORD 5	BIT	SET	RESET
	DSKYFLAG	15	DISPLAYS SENT TO DSKY	NO DISPLAYS TO DSKY
		14	NOT USED	
		13	NOT USED	
	V59FLAG	12	NOT USED IN COAST AND ALIGN LIST	
	INCORFLG	11	NOT USED IN COAST AND ALIGN LIST	

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
42B	FLAGWORD 5	BIT	SET	RESET
	PRFTRKAT	10	NOT USED IN COAST AND ALIGN LIST	
	DMENFLG	9	NOT USED IN COAST AND ALIGN LIST	
	COMPUTER	8	COMPUTER IS CMC	COMPUTER IS LGC
	ENGONFLG	7	NOT USED IN COAST AND ALIGN LIST	
	3AXISFLG	6	MANEUVER SPECIFIED BY THREE AXES	MANEUVER SPECIFIED BY ONE AXIS
	GRRBKFLG	5	BACKUP GRR RECEIVED	BACKUP GRR NOT RECEIVED
	R60FLAG	4	NOT USED IN COAST AND ALIGN LIST	
	SOLNSW	3	NOT USED IN COAST AND ALIGN LIST	
	MGLVFLAG	2	NOT USED IN COAST AND ALIGN LIST	
	RENDWFLG	1	NOT USED IN COAST AND ALIGN LIST	
43A	FLAGWORD 6	BIT	SET	RESET
	DAPBIT1, DAPBIT2	15	0 } NO DAP 0 } CSM	1 } TVC 1 } SATURN
		14	0 } ENTRY OR 1 } DAP RCS	0 } DAP 1 } DAP
	ENTRYDSP	13	NOT USED IN COAST AND ALIGN LIST	
	CMDAPARM	12	NOT USED IN COAST AND ALIGN LIST	
	GAMDIFSW	11	NOT USED IN COAST AND ALIGN LIST	
	GONEPAST	10	NOT USED IN COAST AND ALIGN LIST	
	RELVELSW	9	NOT USED IN COAST AND ALIGN LIST	
	KNOWNFLG	8	NOT USED IN COAST AND ALIGN LIST	
	FIRSTPAS	7	NOT USED IN COAST AND ALIGN LIST	
	HINK	6	NOT USED IN COAST AND ALIGN LIST	
	INRLSW	5	NOT USED IN COAST AND ALIGN LIST	
	LATSW	4	NOT USED IN COAST AND ALIGN LIST	
	.05GSW	3	NOT USED IN COAST AND ALIGN LIST	
	CM/DSTBY	2	NOT USED IN COAST AND ALIGN LIST	
	GYMDIFSW	1	NOT USED IN COAST AND ALIGN LIST	
43B	FLAGWORD 7	BIT	SET	RESET
	TERMIFLG	15	NOT USED IN COAST AND ALIGN LIST	
	ITSWICH	14	NOT USED IN COAST AND ALIGN LIST	
	IGNFLAG	13	NOT USED IN COAST AND ALIGN LIST	
	ASTNFLAG	12	NOT USED IN COAST AND ALIGN LIST	
	TIMRFLAG	11	NOT USED IN COAST AND ALIGN LIST	
	NORMSW	10	NOT USED IN COAST AND ALIGN LIST	
	RVSW	9	NOT USED IN COAST AND ALIGN LIST	
	GONEBY	8	NOT USED IN COAST AND ALIGN LIST	
	IDLEFLAG	7	NO DV MONITOR	CONNECT DV MONITOR
	V37FLAG	6	AVERAGE G (SERVICER) RUNNING	AVERAGE G (SERVICER) OFF
	NOUPFLAG, R32FLAG	5	NEITHER CSM NOR LM STATE VECTOR MAY BE UPDATED	EITHER STATE VECTOR MAY BE UPDATED
	UPLOCKFL	4	K-$\overline{K}$-K FAIL	NO K-$\overline{K}$-K FAIL
	VERIFLAG	3	NOT USED IN COAST AND ALIGN LIST	
	ATTCHFLG	2	LM, CM ATTACHED	LM, CM NOT ATTACHED
	TFFSW	1	NOT USED IN COAST AND ALIGN LIST	
44A	FLAGWORD 8	BIT	SET	RESET
	RPQFLAG	15	RPQ NOT COMPUTED	RPQ COMPUTED
		14	NOT USED	
	NEWIFLG	13	FIRST PASS THROUGH INTEGRATION	SUCCEEDING INTEGRATION OF INTEGRATION

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
		BIT	SET	RESET
44A	FLAGWORD 8			
	CMOONFLG	12	PERMANENT CSM STATE IN LUNAR SPHERE	PERMANENT CSM STATE IN EARTH SPHERE
	LMOONFLG	11	PERMANENT LM STATE IN LUNAR SPHERE	PERMANENT LM STATE IN EARTH SPHERE
	ADVTRK	10	ADVANCE GROUND TRACK SIGHTING WANTED	NOT ADVANCED GROUND TRACK
	P39/79SW	9	NOT USED IN COAST AND ALIGN LIST	
	SURFFLAG	8	NOT USED IN COAST AND ALIGN LIST	
	INFINFLG	7	NOT USED IN COAST AND ALIGN LIST	
	ORDERSW	6	1ST ORDER ITERATOR	2ND ORDER ITERATOR
	APSESW	5	NOT USED IN COAST AND ALIGN LIST	
	COGAFLAG	4	NOT USED IN COAST AND ALIGN LIST	
		3	NOT USED	
		2	NOT USED	
	360SW	1	NOT USED IN COAST AND ALIGN LIST	
44B	FLAGWORD 9	BIT	SET	RESET
	SWTOVER	15	NOT USED IN COAST AND ALIGN LIST	
	V67FLAG	14	NOT USED IN COAST AND ALIGN LIST	
	V82EMFLG	13	NOT USED IN COAST AND ALIGN LIST	
	MAXDBFLG	12	MAX DB SELECTED	MAX DB NOT SELECTED
	V94FLAG	11	NOT USED IN COAST AND ALIGN LIST	
	SAVECFLG	10	NOT USED IN COAST AND ALIGN LIST	
	VHFRFLAG	9	NOT USED IN COAST AND ALIGN LIST	
	SOURCFLG	8	NOT USED IN COAST AND ALIGN LIST	
		7	NOT USED	
	N22ORN17	6	COMPUTE TOTAL ATTITUDE ERRORS WRT N22 (V62)	COMPUTE TOTAL ATTITUDE ERRORS WRT N17 (V63)
	QUITFLAG	5	CAUSE INTEGRATION TO EXIST AT NEXT TIME STOP	ALLOW INTEGRATION TO CONTINUE
	R31FLAG	4	NOT USED IN COAST AND ALIGN LIST	
	MID1FLAG	3	INTEGRATE TO TDEC	INTEGRATE TO THE THEN-PRESENT TIME
	MIDAVFLG	2	INTEGRATION ENTERED FROM ONE OF MIDTOAV PORTALS	INTEGRATION WAS NOT ENTERED VIA MIDTOAV
	AVEMIDSW	1	AVETOMID CALLING FOR W MATRIX INTEGER DON'T WRITE OVER RN, VN, PIPTIME	NO AVETOMID W INTEGER ALLOW SET UP OF RN, VN, PIPTIME
45A	DSPTAB	DISPLAY TABLE CODES FOR GENERATION OF DSKY NUMERICS		
45B	DSPTAB + 1			
46A	DSPTAB + 2			
46B	DSPTAB + 3			
47A	DSPTAB + 4	USED TO INDICATE VERB-NOUN MAJOR MODE AND R_1, R_2, AND R_3 DISPLAYS		
47B	DSPTAB + 5			
48A	DSPTAB + 6			
48B	DSPTAB + 7			
49A	DSPTAB + 8			
49B	DSPTAB + 9			
50A	DSPTAB + 10			
50B	DSPTAB + 11	DISPLAY TABLE OF DSKY STATUS LIGHTS 60400_8 = PROGRAM CAUTION, 60200_8 = TRACKER WARNING 60020_8 = NO ATTITUDE, 60040_8 = GIMBAL LOCK		

COAST AND ALIGN - Continued

TRANSMITTED IN PROGRAMS 00,01,02,03,06,07,11,51,52,53,54

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
51A 51B	TIME2, TIME1	COMPUTER CLOCK INDICATING ELAPSED TIME SINCE LIFTOFF
52A 52B	R_X X COMPONENT OF "OTHER" VEHICLE POSITION	"OTHER" VEHICLE STATE VECTOR
53A 53B	R_Y Y COMPONENT OF "OTHER" VEHICLE POSITION	
54A 54B	R_Z Z COMPONENT OF "OTHER" VEHICLE POSITION	
55A 55B	V_X X COMPONENT OF "OTHER" VEHICLE VELOCITY	
56A 56B	V_Y Y COMPONENT OF "OTHER" VEHICLE VELOCITY	
57A 57B	V_Z Z COMPONENT OF "OTHER" VEHICLE VELOCITY	
58A 58B	T_{OTHER} TIME TAG FOR "OTHER" STATE VECTOR	
59A 59B 60A	CDUX CDUY CDUZ	SAME AS 9A SAME AS 9B SAME AS 10A
60B	CDUT	SAME AS 10B
61A 61B	$ADOT_X$	SAME AS 11A, 11B
62A 62B	$ADOT_Y$	SAME AS 12A, 12B
63A 63B	$ADOT_Z$	SAME AS 13A, 13B
64A 64B 65A	AK AK1 AK2	SAME AS 14A SAME AS 14B SAME AS 15A
65B	RCSFLAGS	SAME AS 15B
66A 66B 67A	$THETAD_X$ $THETAD_Y$ $THETAD_Z$	SAME AS 16A SAME AS 16B SAME AS 17A
67B	$DELCDU_X$	SAME AS 17B
68A 68B	RSBBQ, +1	VALUE OF BBANK AND Q REGISTERS AT THE TIME OF A RESTART

TRANSMITTED IN PROGRAMS 00,01,02,03,06,07,11,51,52,53,54

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
69A	CADRFLSH	VALUE OF RETURN ADDRESS INFORMATION FOR LAST REQUESTED PRIORITY DISPLAY
69B	CADRFLSH+1	VALUE OF RETURN ADDRESS INFORMATION FOR LAST REQUESTED MARK
70A	CADRFLSH+2	VALUE OF RETURN ADDRESS INFORMATION FOR LAST NORMAL DISPLAY REQUESTED
70B 71A 71B	FAILREG FAILREG+1 FAILREG+2	CONTAINS ALARM CODE OF FIRST ALARM RECEIVED CONTAINS ALARM CODE OF SECOND ALARM RECEIVED CONTAINS ALARM CODE OF THIRD ALARM RECEIVED
72A	CDUS	SHAFT CDU INPUT COUNTER
72B 73A 73B	PIPAX PIPAY PIPAZ	X, Y, AND Z PIPA INPUT COUNTERS. ZEROED AT THE START OF AVERAGE G, READ EVERY 2 SEC DURING AVERAGE G ROUTINE.
74A 74B	OGC	X GYRO TORQUE ANGLE.
75A 75B	IGC	Y GYRO TORQUE ANGLE.
76A 76B	MGC	Z GYRO TORQUE ANGLE.
77A	FLAGWORD 10	
77B	FLAGWORD 11	NOT USED
78A 78B	TEVENT	VALUE OF COMPUTER CLOCK WHEN LIFTOFF OCCURRED, WHEN SPS ENGINE CAME ON OR WHEN SPS ENGINE SHUT OFF
79A 79B	LAUNCHAZ	LAUNCH AZIMUTH ANGLE (ANGLE FROM NORTH TO X STABLE MEMBER)

FLAGWORD 10

BIT	SET	RESET
15	NOT USED	
14	INTEGRATION IN PROGRESS	INTEGRATION NOT IN PROGRESS
13	NOT USED	
12	NOT USED	
11	NOT USED	
10	NOT USED	
9	NOT USED	
8	NOT USED	
7	INTEGRATION ROUTINE TO BE RESTARTED	INTEGRATION ROUTINE NOT TO BE RESTARTED
6	NOT USED	
5	NOT USED	
4	NOT USED	
3	NOT USED	
2	NOT USED	
1	NOT USED	

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
80A	OPTMODES	BIT	SET	RESET
		15	NOT ASSIGNED - SHOULD BE ZERO	
		14	NOT ASSIGNED - SHOULD BE ZERO	
		13	NOT ASSIGNED - SHOULD BE ZERO	
		12	NOT ASSIGNED - SHOULD BE ZERO	
		11	NOT ASSIGNED - SHOULD BE ZERO	
		10	INDICATES OPTICS HAS BEEN ZEROED SINCE LAST FRESH START	ALARM 1208 WILL BE GENERATED IF ATTEMPT IS MADE TO ZERO OPTICS
		9	OPTICS MODE SWITCH IN COMPUTER POSITION	RESET BY FRESH START OR MODE OTHER THAN CMC
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	OPTICS CDU FAIL PRESENTLY	NO OPTICS CDU FAIL PRESENTLY
		6	NOT ASSIGNED - SHOULD BE ZERO	
		5	OPTICS MODE SWITCH NOT IN CMC POSITION	OPTICS MODE SWITCH IN CMC POSITION
		4	OPTICS ZERO SWITCH NOT IN ZERO POSITION	OPTICS ZERO SWITCH IN ZERO POSITION
			(BITS 4, 5 = 1'S OPTICS IN MANUAL MODE)	
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	NOT ASSIGNED - SHOULD BE ZERO	
		1	NOT ASSIGNED - SHOULD BE ZERO	
80B	HOLDFLAG	USED TO DETERMINE NATURE OF ATTITUDE HOLD CONTROL IN CSM RCS DAP. IF >+0, PERFORM ATTITUDE HOLD ABOUT ANGLES CONTAINED IN CDU INPUT COUNTERS (PRESENT IMU ANGLES). IF = +0, PERFORM ATTITUDE HOLD ABOUT EXISTING REFERENCE. IF <+0, AUTOMATIC STEERING IS TO BE PERFORMED.		
81A	LEMMASS	MASS OF THE LM		
81B	CSMMASS	MASS OF THE CSM		
82A	DAPDATR1 LOADED WITH V48N46E	BITS		
		15	NOT USED - SHOULD BE ZERO	
		14	0 } NO DAP; 0 } LM OFF; 1 } LM ON RCS DAP	1 } SATURN DAP
		13	0 } NO DAP; 1 } RCS DAP	0 } RCS DAP; 1 } SATURN DAP
		12	NOT USED - SHOULD BE ZERO	
		11	NOT USED - SHOULD BE ZERO	
		10	X TRANSLATIONS 0 1 } USE AC&BD QUADS	0 } USE AC QUADS; 1 } USE BD QUADS
		7	USES 0 1 } OR	
		9	NOT USED - SHOULD BE ZERO	
		8	NOT USED - SHOULD BE ZERO	
		6	NOT USED - SHOULD BE ZERO	
		5	NOT USED - SHOULD BE ZERO	
		4	ANGULAR DEADBAND FOR ATTITUDE HOLD AND AUTOMATIC MANEUVERS 0 - ±0.5° DEADBAND 1 - ±5.0° DEADBAND	
		3	NOT USED - SHOULD BE ZERO	
		2	SPECIFY MANEUVER RATE 0 } .05°/SEC; 1 } .2°/SEC	0 } .5°/SEC; 1 } .5°/SEC 4
		1		

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
80A	OPTMODES	BIT / SET / RESET
		15 — NOT ASSIGNED - SHOULD BE ZERO
		14 — NOT ASSIGNED - SHOULD BE ZERO
		13 — NOT ASSIGNED - SHOULD BE ZERO
		12 — NOT ASSIGNED - SHOULD BE ZERO
		11 — NOT ASSIGNED - SHOULD BE ZERO
		10 — SET: INDICATES OPTICS HAS BEEN ZEROED SINCE LAST FRESH START; RESET: ALARM 1208 WILL BE GENERATED IF ATTEMPT IS MADE TO ZERO OPTICS
		9 — SET: OPTICS MODE SWITCH IN COMPUTER POSITION; RESET: RESET BY FRESH START OR MODE OTHER THAN CMC
		8 — NOT ASSIGNED - SHOULD BE ZERO
		7 — SET: OPTICS CDU FAIL PRESENTLY; RESET: NO OPTICS CDU FAIL PRESENTLY
		6 — NOT ASSIGNED - SHOULD BE ZERO
		5 — SET: OPTICS MODE SWITCH NOT IN CMC POSITION; RESET: OPTICS MODE SWITCH IN CMC POSITION
		4 — SET: OPTICS ZERO SWITCH NOT IN ZERO POSITION; RESET: OPTICS ZERO SWITCH IN ZERO POSITION
		(BITS 4, 5 = 1'S OPTICS IN MANUAL MODE)
		3 — NOT ASSIGNED - SHOULD BE ZERO
		2 — NOT ASSIGNED - SHOULD BE ZERO
		1 — NOT ASSIGNED - SHOULD BE ZERO
80B	HOLDFLAG	USED TO DETERMINE NATURE OF ATTITUDE HOLD CONTROL IN CSM RCS DAP. IF >+0, PERFORM ATTITUDE HOLD ABOUT ANGLES CONTAINED IN CDU INPUT COUNTERS (PRESENT IMU ANGLES). IF = +0, PERFORM ATTITUDE HOLD ABOUT EXISTING REFERENCE. IF <+0, AUTOMATIC STEERING IS TO BE PERFORMED.
81A	LEMMASS	MASS OF THE LM
81B	CSMMASS	MASS OF THE CSM
82A	DAPDATR1 LOADED WITH V48N46E	BITS
		15 — NOT USED - SHOULD BE ZERO
		14 — 0 = NO DAP, 1 = LM OFF, RCS DAP; 13 — 0 = LM RCS DAP, 1 = SATURN DAP
		12 — NOT USED - SHOULD BE ZERO
		11 — NOT USED - SHOULD BE ZERO
		10 — X TRANSLATIONS USES 0 = USE AC&BD QUADS OR 1 = USE AC QUADS; 7 — 0 = USE BD QUADS, 1 = USE AC QUADS
		9 — NOT USED - SHOULD BE ZERO
		8 — NOT USED - SHOULD BE ZERO
		6 — NOT USED - SHOULD BE ZERO
		5 — NOT USED - SHOULD BE ZERO
		4 — ANGULAR DEADBAND FOR ATTITUDE HOLD AND AUTOMATIC MANEUVERS 0 - ±0.5° DEADBAND 1 - ±5.0° DEADBAND
		3 — NOT USED - SHOULD BE ZERO
		2, 1 — SPECIFY MANEUVER RATE: 0 0 = .05°/SEC, 0 1 = .2°/SEC, 1 0 = .5°/SEC, 1 1 = .5°/SEC

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
80A	OPTMODES	BIT / SET / RESET
		15 — NOT ASSIGNED - SHOULD BE ZERO
		14 — NOT ASSIGNED - SHOULD BE ZERO
		13 — NOT ASSIGNED - SHOULD BE ZERO
		12 — NOT ASSIGNED - SHOULD BE ZERO
		11 — NOT ASSIGNED - SHOULD BE ZERO
		10 — SET: INDICATES OPTICS HAS BEEN ZEROED SINCE LAST FRESH START; RESET: ALARM 1208 WILL BE GENERATED IF ATTEMPT IS MADE TO ZERO OPTICS
		9 — SET: OPTICS MODE SWITCH IN COMPUTER POSITION; RESET: RESET BY FRESH START OR MODE OTHER THAN CMC
		8 — NOT ASSIGNED - SHOULD BE ZERO
		7 — SET: OPTICS CDU FAIL PRESENTLY; RESET: NO OPTICS CDU FAIL PRESENTLY
		6 — NOT ASSIGNED - SHOULD BE ZERO
		5 — SET: OPTICS MODE SWITCH NOT IN CMC POSITION; RESET: OPTICS MODE SWITCH IN CMC POSITION
		4 — SET: OPTICS ZERO SWITCH NOT IN ZERO POSITION; RESET: OPTICS ZERO SWITCH IN ZERO POSITION
		(BITS 4, 5 = 1'S OPTICS IN MANUAL MODE)
		3 — NOT ASSIGNED - SHOULD BE ZERO
		2 — NOT ASSIGNED - SHOULD BE ZERO
		1 — NOT ASSIGNED - SHOULD BE ZERO
80B	HOLDFLAG	USED TO DETERMINE NATURE OF ATTITUDE HOLD CONTROL IN CSM RCS DAP. IF >+0, PERFORM ATTITUDE HOLD ABOUT ANGLES CONTAINED IN CDU INPUT COUNTERS (PRESENT IMU ANGLES). IF = +0, PERFORM ATTITUDE HOLD ABOUT EXISTING REFERENCE. IF <+0, AUTOMATIC STEERING IS TO BE PERFORMED.
81A	LEMMASS	MASS OF THE LM
81B	CSMMASS	MASS OF THE CSM
82A	DAPDATR1 LOADED WITH V48N46E	BITS
		15 — NOT USED - SHOULD BE ZERO
		14 — 0 NO DAP / 1 NO DAP; 13 — 0 LM OFF / 1 RCS DAP; 12 — 0 LM RCS DAP / 1 LM RCS DAP; 11 — 0 SATURN DAP / 1 SATURN DAP
		12 — NOT USED - SHOULD BE ZERO
		11 — NOT USED - SHOULD BE ZERO
		10 — X TRANSLATIONS USES 0 OR 1 QUADS; 9 — 0 USE AC&BD QUADS / 1 USE AC QUADS; 8 — 1 USE BD QUADS
		9 — NOT USED - SHOULD BE ZERO
		8 — NOT USED - SHOULD BE ZERO
		6 — NOT USED - SHOULD BE ZERO
		5 — NOT USED - SHOULD BE ZERO
		4 — ANGULAR DEADBAND FOR ATTITUDE HOLD AND AUTOMATIC MANEUVERS 0 - ±0.5° DEADBAND 1 - ±5.0° DEADBAND
		3 — NOT USED - SHOULD BE ZERO
		2 — SPECIFY MANEUVER RATE; 1 — 0 .05°/SEC / 1 .2°/SEC; 0 — 0 .5°/SEC / 1 .5°/SEC

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
80A	OPTMODES	BIT / SET / RESET
		15 — NOT ASSIGNED - SHOULD BE ZERO
		14 — NOT ASSIGNED - SHOULD BE ZERO
		13 — NOT ASSIGNED - SHOULD BE ZERO
		12 — NOT ASSIGNED - SHOULD BE ZERO
		11 — NOT ASSIGNED - SHOULD BE ZERO
		10 — SET: INDICATES OPTICS HAS BEEN ZEROED SINCE LAST FRESH START; RESET: ALARM 120_8 WILL BE GENERATED IF ATTEMPT IS MADE TO ZERO OPTICS
		9 — SET: OPTICS MODE SWITCH IN COMPUTER POSITION; RESET: RESET BY FRESH START OR MODE OTHER THAN CMC
		8 — NOT ASSIGNED - SHOULD BE ZERO
		7 — SET: OPTICS CDU FAIL PRESENTLY; RESET: NO OPTICS CDU FAIL PRESENTLY
		6 — NOT ASSIGNED - SHOULD BE ZERO
		5 — SET: OPTICS MODE SWITCH NOT IN CMC POSITION; RESET: OPTICS MODE SWITCH IN CMC POSITION
		4 — SET: OPTICS ZERO SWITCH NOT IN ZERO POSITION; RESET: OPTICS ZERO SWITCH IN ZERO POSITION
		(BITS 4, 5 = 1'S OPTICS IN MANUAL MODE)
		3 — NOT ASSIGNED - SHOULD BE ZERO
		2 — NOT ASSIGNED - SHOULD BE ZERO
		1 — NOT ASSIGNED - SHOULD BE ZERO
80B	HOLDFLAG	USED TO DETERMINE NATURE OF ATTITUDE HOLD CONTROL IN CSM RCS DAP. IF >+0, PERFORM ATTITUDE HOLD ABOUT ANGLES CONTAINED IN CDU INPUT COUNTERS (PRESENT IMU ANGLES). IF = +0, PERFORM ATTITUDE HOLD ABOUT EXISTING REFERENCE. IF <+0, AUTOMATIC STEERING IS TO BE PERFORMED.
81A	LEMMASS	MASS OF THE LM
81B	CSMMASS	MASS OF THE CSM
82A	DAPDATR1 LOADED WITH V48N46E	BITS
		15 — NOT USED - SHOULD BE ZERO
		14–13 — 0 NO DAP, 1 DAP; 0 LM OFF DAP, 1 RCS DAP; 0 LM ON RCS DAP, 1 SATURN DAP
		12 — NOT USED - SHOULD BE ZERO
		11 — NOT USED - SHOULD BE ZERO
		10–7 — X TRANSLATIONS USES: 0 OR 1 USE AC&BD QUADS; 0 USE AC QUADS, 1 USE BD QUADS
		9 — NOT USED - SHOULD BE ZERO
		8 — NOT USED - SHOULD BE ZERO
		6 — NOT USED - SHOULD BE ZERO
		5 — NOT USED - SHOULD BE ZERO
		4 — ANGULAR DEADBAND FOR ATTITUDE HOLD AND AUTOMATIC MANEUVERS 0 - ±0.5° DEADBAND 1 - ±5.0° DEADBAND
		3 — NOT USED - SHOULD BE ZERO
		2–1 — SPECIFY MANEUVER RATE: 0 .05° / SEC, 1 .2° / SEC, 0 .5° / SEC, 1 .5° / SEC

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
82B	DAPDATR2	BITS 15 NOT USED - SHOULD BE ZERO 14 NOT USED - SHOULD BE ZERO 13 ROLL JET SELECTION 0 - USE QUAD AC FOR ROLL MANEUVERS 1 - USE QUAD BD FOR ROLL MANEUVERS 12 NOT USED - SHOULD BE ZERO 11 NOT USED - SHOULD BE ZERO 10 A QUAD FAIL 0 - QUAD A IS OK 1 - QUAD A FAILED 9 NOT USED - SHOULD BE ZERO 8 NOT USED - SHOULD BE ZERO 7 B QUAD FAIL 0 - QUAD B IS OK 1 - QUAD B FAILED 6 NOT USED - SHOULD BE ZERO 5 NOT USED - SHOULD BE ZERO 4 C QUAD FAIL 0 - QUAD C IS OK 1 = QUAD C FAILED 3 NOT USED - SHOULD BE ZERO 2 NOT USED - SHOULD BE ZERO 1 D QUAD FAIL 0 - QUAD D IS OK 1 - QUAD D FAILED
83A 83B 84A	ERROR$_X$ ERROR$_Y$ ERROR$_Z$	INTERMEDIATE ATTITUDE ERRORS COMPUTED DURING CSM RCS DAP (DAP FOLLOWING ERRORS). ERRORS IN CONTROL COORDINATES AND ARE LOADED INTO AK'S FOR FDAI DISPLAY WHEN FWD0 BIT 9 = 0
84B	THETAD$_X$	SAME AS 16A
85A 85B	WBODY	DESIRED BODY ROLL RATE ABOUT CONTROL AXIS
86A 86B	WBODY1	DESIRED BODY PITCH RATE ABOUT CONTROL AXIS
87A 87B	WBODY2	DESIRED BODY YAW RATE ABOUT CONTROL AXIS
88A	REDOCTR	INDICATES THE NUMBER OF RESTARTS WHICH HAVE OCCURRED SINCE LAST FRESH START
88B 89A 89B	THETAD THETAD+1 THETAD+2	FINAL DESIRED X CDU ANGLE FINAL DESIRED Y CDU ANGLE FINAL DESIRED Z CDU ANGLE
90A	IMODES30	BIT / SET / RESET 15 / IMU TEMPERATURE OUT OF LIMITS / IMU TEMPERATURE WITHIN LIMITS 14 / NO ISS TURN ON REQUEST PRESENT / ISS TURN ON REQUEST PRESENT

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
90A	IMODES30	BIT	SET	RESET
		13	NO IMU FAIL	IMU FAIL HAS OCCURRED
		12	NO ICDU FAIL	ICDU FAIL HAS OCCURRED
		11	NO IMU CAGE COMMANDED	IMU CAGE HAS BEEN COMMANDED
		10	NO PIPA FAIL	PIPA FAIL HAS OCCURRED
		9	IMU NOT OPERATING	IMU OPERATING
		8	USED IN IMU TURN-ON SEQUENCING MOST LIKELY BE ZERO	
		7	SAME AS BIT 8	
		6	IMU INITIALIZATION BEING ACCOMPLISHED	IMU NOT IN INITIALIZATION
		5	INHIBIT ALARM 212_8 IF PIPA FAIL OCCURS	DO NOT INHIBIT ALARM 212_8 IF PIPA FAIL OCCURS
		4	INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF IMU FAIL OCCURS	DO NOT INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF IMU FAIL OCCURS
		3	INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF ICDU FAIL OCCURS	DO NOT INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF ICDU FAIL OCCURS
		2	TURN-ON DELAY FAILURE (ALARM 207_8)	NO TURN-ON DELAY FAILURE
		1	INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF A PIPA FAIL OCCURS	DO NOT INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF A PIPA FAIL OCCURS
90B	IMODES33	BIT	SET	RESET
		15	NOT ASSIGNED - SHOULD BE ZERO	
		14		PROCEED DEPRESSED
		13	PIPA FAIL HAS NOT OCCURRED	PIPA FAIL HAS OCCURRED
		12	TELEMETRY DOWNLINK OK	TELEMETRY DOWNLINK IS TOO FAST
		11	UPLINK IS OK	UPLINK IS TOO FAST
		10	NOT ASSIGNED - SHOULD BE ZERO	
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NOT ASSIGNED - SHOULD BE ZERO	
		6	IMU IN COARSE ALIGN OR ZEROING MODE	IMU NOT IN COARSE ALIGN OR ZEROING MODE
		5	IMU IN ZEROING ROUTINE	IMU NOT IN ZEROING ROUTINE
		4	NOT ASSIGNED - SHOULD BE ZERO	
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	NOT USED	
		1	LAMP TEST IN PROGRESS (V35)	LAMP TEST NOT IN PROGRESS
91A	CHANNEL 11	BIT	SET	RESET
		15	NOT ASSIGNED - SHOULD BE ZERO	
		14	NOT ASSIGNED - SHOULD BE ZERO	
		13	SPS ENGINE ON COMMAND	
		12	NOT ASSIGNED - SHOULD BE ZERO	

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
91A	CHANNEL 11	BIT	SET	RESET
		11	NOT ASSIGNED - SHOULD BE ZERO	
		10	ERROR RESET KEYCODE RECEIVED FROM UPLINK OR DSKY	
		9	INDICATES AVERAGE G ROUTINE IS RUNNING	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	OPERATOR ERROR HAS OCCURRED	
		6	VERB-NOUN FLAHSER ON	
		5	KEY RELEASE LAMP ON	
		4	IMU TEMPERATURE IS OUT OF LIMITS	
		3	UPLINK ACTIVITY LAMP ON	
		2	COMPUTER ACTIVITY LAMP ON	
		1	ISS WARNING LAMP ON	
91B	CHANNEL 12	BIT	SET	RESET
		15	TURN ON DELAY - COMPLETE	
		14	S-IVB CUTOFF COMMAND	
		13	S-IVB INJECTION SEQUENCING START	
		12	NOT ASSIGNED - SHOULD BE ZERO	
		11	DISENGAGE OPTICS DAC	
		10	ZERO OPTICS COMMAND	
		9	S-IVB TAKEOVER ENABLE	
		8	TVC ENABLE	
		7	NOT ASSIGNED - SHOULD BE ZERO	
		6	IMU CDU ERROR COUNTER ENABLE	
		5	IMU CDU ZERO COMMAND	
		4	IMU COARSE ALIGN ENABLE	
		3	STAR TRACKERS ON	
		2	OPTICS CDU ERROR COUNTER ENABLE	
		1	OPTICS CDU ZERO COMMAND	
92A	CHANNEL 13	BIT	SET	RESET
		15	T6RUPT ENABLE	
		14	RESET TRAP 32	
		13	RESET TRAP 31-B	
		12	RESET TRAP 31-A	
		11	ENABLE STANDBY BUTTON	
		10	LAMP TEST BEING PERFORMED	
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	BMAG OUTPUT ENABLE	
		7	WORD ORDER CODE FOR WORDS 2-50, 52-100	WORD ORDER CODE FOR WORDS 1 AND 51
		6	BLOCK UPLINK	
		5	INHIBIT UPLINK, ENABLE CROSSLINK	

COAST AND ALIGN - Continued

TRANSMITTED IN PROGRAMS 00,01,02,03,06,07,11,51,52,53,54

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
92A	CHANNEL 13	BIT	SET	RESET
		4	RANGE UNIT ACTIVITY	
		3	RANGE UNIT SELECT A	
		2	RANGE UNIT SELECT B	
		1	RANGE UNIT SELECT C	
92B	CHANNEL 14	BIT	SET	RESET
		15	XCDU DRIVE ENABLE	
		14	YCDU DRIVE ENABLE	
		13	ZCDU DRIVE ENABLE	
		12	TRUNNION CDU DRIVE ENABLE	
		11	SHAFT CDU DRIVE ENABLE	
		10	GYRO TORQUING ENABLE	
		9	NEGATIVE GYRO TORQUE	POSITIVE GYRO TORQUE
		8	GYRO SELECT 0 0 NO GYRO 0 1 X GYRO 1 0 Y GYRO 1 1 Z GYRO	
		7		
		6	GYRO PULSE TORQUE POWER SUPPLY ENABLED	
		5	NOT USED - SHOULD BE ZERO	
		4	NOT ASSIGNED - SHOULD BE ZERO	
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	NOT ASSIGNED - SHOULD BE ZERO	
		1	NOT USED - SHOULD BE ZERO	
93A	CHANNEL 30	BIT	SET	RESET
		15	IMU TEMPERATURE OUT OF LIMITS	IMU TEMPERATURE WITHIN LIMITS
		14	ISS OFF	ISS ON OR COMMANDED ON
		13	NO IMU FAIL	IMU FAILURE
		12	NO ICDU FAIL	ICDU FAILURE
		11	NO IMU CAGE COMMANDED	IMU CAGE COMMANDED
		10		LAUNCH VEHICLE GUIDANCE SWITCH IN CMC POSITION
		9	IMU NOT OPERATING	IMU OPERATING
		8	NOT ASSIGNED - SHOULD BE SET	
		7	NO OCDU FAIL	OCDU FAILURE
		6	NOT USED	
		5	LIFTOFF HAS NOT OCCURRED	LIFTOFF HAS OCCURRED
		4	S-IVB ATTACHED	S-IVB SEPARATED
		3	SPS NOT READY	SPS READY
		2	CM/SM ATTACHED	CM/SM SEPARATED
		1	ULLAGE THRUST NOT PRESENT FOR S-IVB	ULLAGE THRUST PRESENT FROM S-IVB
93B	CHANNEL 31	BIT	SET	RESET
		15	COMPUTER NOT IN CONTROL OF SPACECRAFT	COMPUTER IN CONTROL OF SPACECRAFT
		14	CSM RCS 0 DAP MODE 0 ILLEGAL	0 1 FREE MODE 1 0 HOLD MODE 1 1 AUTO MODE
		13		

TRANSMITTED IN PROGRAMS 00,01,02,03,06,07,11,51,52,53,54

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
93B	CHANNEL 31	BIT	SET	RESET
	THC INPUTS	12		-Z TRANSLATION COMMANDED
		11		+Z TRANSLATION COMMANDED
		10		-Y TRANSLATION COMMANDED
		9		+Y TRANSLATION COMMANDED
		8		-X TRANSLATION COMMANDED
		7		+X TRANSLATION COMMANDED
	RHC INPUTS	6		-ROLL COMMANDED
		5		+ROLL COMMANDED
		4		-YAW COMMANDED
		3		+YAW COMMANDED
		2		-PITCH COMMANDED
		1		+PITCH COMMANDED
94A	CHANNEL 32	BIT	SET	RESET
		15	NOT ASSIGNED - SHOULD BE ZERO	
		14		PROCEED KEY IS DEPRESSED
		13	NOT ASSIGNED - SHOULD BE ZERO	
		12	NOT ASSIGNED - SHOULD BE ZERO	
		11		LM ATTACHED
		10	NOT ASSIGNED - SHOULD BE ZERO	
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NOT ASSIGNED - SHOULD BE ZERO	
	MINIMUM IMPULSE CONTROLLER INPUTS	6		-ROLL COMMANDED
		5		+ROLL COMMANDED
		4		-YAW COMMANDED
		3		+YAW COMMANDED
		2		-PITCH COMMANDED
		1		+PITCH COMMANDED
94B	CHANNEL 33	BIT	SET	RESET
		15		COMPUTER OSCILLATOR HAS FAILED
		14		CMC WARNING HAS OCCURRED
		13		PIPA FAIL HAS OCCURRED
		12		TELEMETRY DOWNLINK IS TOO FAST
		11		UPLINK IS TOO FAST
		10	BLOCK UPLINK SWITCH IN NORMAL POSITION	BLOCK UPLINK SWITCH IN BLOCK POSITION
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NOT ASSIGNED - SHOULD BE ZERO	
		6	NOT ASSIGNED - SHOULD BE ZERO	
		5	OPTICS MODE SWITCH IN MANUAL POSITION	OPTICS MODE SWITCH IN COMPUTER POSITION
		4	OPTICS ZERO SWITCH IN NORMAL POSITION	OPTICS ZERO SWITCH IN ZERO POSITION
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	RANGE UNIT DATA NO GOOD	RANGE UNIT DATA GOOD
		1	NOT ASSIGNED - SHOULD BE ZERO	

TRANSMITTED IN PROGRAMS 00,01,02,03,06,07,11,51,52,53,54

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
95A	DSPTAB	
95B	DSPTAB + 1	
96A	DSPTAB + 2	
96B	DSPTAB + 3	
97A	DSPTAB + 4	
97B	DSPTAB + 5	
98A	DSPTAB + 6	SAME AS 49A THROUGH 50B
98B	DSPTAB + 7	
99A	DSPTAB + 8	
99B	DSPTAB + 9	
100A	DSPTAB + 10	
100B	DSPTAB + 11	

RENDEZVOUS AND PRETHRUST

TRANSMITTED IN PROGRAMS 17,20,21,23,30,31,34,35,37,38,39,74,75,77,78,79

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
1A	LIST ID	(77775)8 INDICATES RENDEZVOUS AND PRETHRUST LIST BEING TRANSMITTED.
1B	SYNC BITS	(77340)8 INDICATES DATA TO FOLLOW.
2A 2B	R_X X COMPONENT OF VEHICLE POSITION VECTOR	CSM VEHICLE STATE VECTOR AND TIME
3A 3B	R_Y Y COMPONENT OF VEHICLE POSITION VECTOR	
4A 4B	R_Z Z COMPONENT OF VEHICLE POSITION VECTOR	
5A 5B	V_X X COMPONENT OF VEHICLE VELOCITY VECTOR	
6A 6B	V_Y Y COMPONENT OF VEHICLE VELOCITY VECTOR	
7A 7B	V_Z Z COMPONENT OF VEHICLE VELOCITY VECTOR	
8A 8B	T_{SV} TIME TAG FOR $\overline{R}$ AND $\overline{V}$	
9A 9B 10A	CDUX CDUY CDUZ	X, Y, AND Z CDU INPUT COUNTERS. READ THE IMU COUNTERS ZEROED DURING ZERO ENCODE MODE (IMODES 33 BIT 5=1).
10B	CDUT	TRUNNION CDU INPUT COUNTER
11A 11B	$ADOT_X$	MEASURED BODY RATES ABOUT THE X, Y, AND Z CONTROL AXES ANY TIME THE RCS DAP IS ON.
12A 12B	$ADOT_Y$	
13A 13B	$ADOT_Z$	
14A 14B 15A	AK AK1 AK2	VEHICLE ATTITUDE ERRORS SENT TO FDAI. DURING P11 THE ROLL (AK) VALUE IS DIVIDED BY 4 SO THAT MAX ERROR DISPLAY IS 4 X 16-2/3°. DURING RCS DAP OPERATION EITHER TOTAL ATTITUDE OR DAP FOLLOWING ERROR IS DISPLAYED (DET. BY FW0 BIT 9).
15B	RCSFLAGS	

BIT	SET	RESET
15	NOT USED - SHOULD BE ZERO	
14	RATE FILTER NOT INITIALIZED	RATE FILTER INITIALIZED
13	ROLL RATE DAMPING REQUIRED	
12	PITCH RATE DAMPING REQUIRED	
11	YAW RATE DAMPING REQUIRED	

TRANSMITTED IN PROGRAMS 17,20,21,23,30,31,34,35,37,38,39,74,75,77,78,79

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
15B	RCSFLAGS	BIT 10: SET: -ROLL RHC INPUT; RESET:
		BIT 9: SET: +ROLL RHC INPUT; RESET:
		BIT 8: SET: -YAW RHC INPUT; RESET:
		BIT 7: SET: +YAW RHC INPUT; RESET:
		BIT 6: SET: -PITCH RHC INPUT; RESET:
		BIT 5: SET: +PITCH RHC INPUT; RESET:
		BIT 4: SET: COMPUTE AK'S (ATTITUDE ERRORS); RESET: PERFORM NEEDLER TO DISPLAY AK'S.
		BIT 3: 0 = 3RD PASS THROUGH; 0 = 2ND PASS THROUGH; 1 = INITIAL PASS THROUGH
		BIT 2: 0 = NEEDLER; 1 = NEEDLER; 1 = NEEDLER
		BIT 1: RESET: INITIALIZE T_6 PROGRAM
16A 16B 17A	$THETAD_X$ $THETAD_Y$ $THETAD_Z$	X, Y, AND Z REFERENCE CDU ANGLES FOR THE ATTITUDE HOLD ROUTINE. INTERMEDIATE DESIRED CDU ANGLES FOR AUTO MANEUVER ROUTINE.
17B	$DELCDU_X$	MOST SIGNIFICANT HALF OF X INCREMENTAL GIMBAL ANGLE USED IN AUTOMATIC MANEUVERS.
18A 18B	TIG	TIME OF IGNITION
19A 19B	DELLT4	TIME REMAINING UNTIL ARRIVAL AT AIMPOINT
20A 20B 21A 21B 22A 22B	$RTARG_X$ $RTARG_Y$ $RTARG_Z$	X, Y, AND Z COMPONENTS OF TARGET POSITION VECTOR
23A 23B	VHFTIME	TIME OF MOST RECENT READING OF RADAR
24A 24B 25A 25B 26A 26B 27A	MARKDOWN (TIME2) MARKDOWN+1 (TIME1) MARKDOWN+2 (CDUY) MARKDOWN+3 (CDUS) MARKDOWN+4 (CDUZ) MARKDOWN+5 (CDUT) MARKDOWN+6 (CDUX)	MARK DATA
27B	RM	RANGE FROM CSM TO LM

RENDEZVOUS AND PRETHRUST - Continued

TRANSMITTED IN PROGRAMS 17,20,21,23,30,31,34,35,37,38,39,74,75,77,78,79

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
28A 28B	VHFCNT TRKMCNT	NUMBER OF RENDEZVOUS VHF RANGE MARKS TAKEN NUMBER OF RENDEZVOUS TRACKING MARKS TAKEN		
29A 29B	TTPI	TIME OF TRANSFER PHASE INITIATION		
30A	ECSTEER	CROSS PRODUCT STEERING CONSTANT		
30B	LSAT	NOT USED		
31A 31B	DELVTPF	MAGNITUDE OF DELTA V AT INTERCEPT TIME		
32A 32B 33A 33B	SPARES			
34A 34B	TPASS4	TIME OF ARRIVAL AT AIMPOINT		
35A 35B 36A 36B 37A 37B	DELVSLV$_X$ DELVSLV$_Y$ DELVSLV$_Z$	SPECIFIED DELTA V IN LOCAL VERTICAL COORDINATES OF ACTIVE VEHICLE AT TIME OF IGNITION		
38A 38B	RANGE	CALCULATED RANGE TO "OTHER" VEHICLE		
39A 39B	RRATE	CALCULATED RANGE RATE TO "OTHER" VEHICLE		
40A	FLAGWORD 0	BIT	SET	RESET
	CPHIFLAG	15	OUTPUT OF CALCGA IS CPHIX	OUTPUT OF CALCGA IS THETAD
	JSWITCH	14	INTEGRATION OF W MATRIX	INTEGRATION OF STATE VECTOR
	MIDFLAG	13	INTEGRATION WITH SOLAR PERTURBATIONS	INTEGRATION WITHOUT SOLAR PERTURBATIONS
	MOONFLAG	12	MOON IS SPHERE OF INFLUENCE	EARTH IS SPHERE OF INFLUENCE
	NORFHOR	11	FAR HORIZON	HEAR HORIZON
	ZMEASURE	10	MEASUREMENT PLANET AND PRIMARY PLANET DIFFERENT	MEASUREMENT PLANET AND PRIMARY PLANET SAME
	NEEDLFLG	9	TOTAL ATTITUDE ERROR DISPLAYED	A/P FOLLOWING ERROR DISPLAYED
	IMUSE	8	IMU IN USE	IMU NOT IN USE
	RNDVZFLG	7	P20 RUNNING (RADAR IN USE)	P20 NOT RUNNING (RADAR NOT IN USE)

RENDEZVOUS AND PRETHRUST - Continued

TRANSMITTED IN PROGRAMS 17,20,21,23,30,31,34,35,37,38,39,74,75,77,78,79

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
40A	FLAGWORD	BIT	SET	RESET
	R53FLAG	6	V51 INITIATED	V51 NOT INITIATED
	F2RTE	5	IN TIME CRITICAL MODE	NOT IN TIME CRITICAL MODE
	TRUNFLAG	4	DRIVING OF TRUNNION ALLOWED	DRIVING OF TRUNNION NOT ALLOWED
	FREEFLAG	3	USED TO CONTROL INTERNAL SUBROUTINE PERFORMANCE	
	B29FLAG	2	NOT USED	
	KFLAG	1	SEARCH SECTOR MORE THAN 180 DEGREES	SEARCH SECTOR LESS THAN 180 DEGREES
40B	FLAGWORD 1	BIT	SET	RESET
	NJETSFLG	15	TWO JET RCS BURN	FOUR JET RCS BURN
	STIKFLAG	14	RHC CONTROL OF RCS	CMC CONTROL OF RCS
	ERADFLAG	13	COMPUTE REARTH FISCHER ELLIPSOID	USE CONSTANT REARTH PAD RADIUS
		12	NOT USED	
	ENG2FLAG	11	RCS BURN	SPS BURN
	TARG1FLG	10	SIGHTING LM	NOT SIGHTING LM
	TARG2FLG, R23FLG	9	SIGHTING LANDMARK R23 MARKING	SIGHTING STAR R21 MARKING
	VEHUPFLG	8	CSM STATE VECTOR BEING UPDATED	LM STATE VECTOR BEING UPDATED
	UPDATFLG	7	UPDATING BY MARKS ALLOWED	UPDATING BY MARKS NOT ALLOWED
	IDLEFAIL	6	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	TRACKFLG	5	TRACKING ALLOWED	TRACKING NOT ALLOWED
		4	NOT USED	
	SLOPESW	3	ITERATE WITH REGULAR FALSI METHOD	ITERATE WITH BIAS METHOD
	GUESSW	2	NO STARTING VALUE FOR ITERATION EXISTS	STARTING VALUE FOR ITERATION EXISTS
	AVEGFLAG	1	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
41A	FLAGWORD 2	BIT	SET	RESET
	DRIFTFLG	15	T3RUPT CALLS GYRO COMPENSATION	T3RUPT DOES NO GYRO COMPENSATION
	R21MARK	14	OPTION ONE FOR MARKRUPT	OPTION TWO FOR MARKRUPT
	22DSPFLG	13	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
		12	NOT USED	
	STERRSW	11	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	CYCLESW	10	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	IMPULSW	9	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	XDELVFLG	8	EXTERNAL DELTAV VG COMPUTATION	LAMBERT (AIMPOINT) VB COMPUTATION
	ETPIFLAG, OPTNSW	7	ELEVATING ANGLE SUPPLIED FOR P34, 74. SOI PHASE P38/P78.	TPI TIME SPECIFIED FOR P34, 74. SOR PHASE OF P38/P78.
	FINALFLG	6	LAST PASS THROUGH RENDEZVOUS PROGRAM COMPUTATIONS	INTERIM PASS THROUGH RENDEZVOUS PROGRAM COMPUTATIONS
	AVFLAG	5	LM VEHICLE IS ACTIVE	CSM VEHICLE IS ACTIVE
	PFRATFLG	4	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	CALCMAN3	3	NO FINAL ROLL	FINAL ROLL IS NECESSARY
	CALCMAN2	2	PERFORM MANEUVER STARTING PROCEDURE	BYPASS STARTING PROCEDURE
	NODOFLAG	1	V37 NOT PERMITTED	V37 PERMITTED

TRANSMITTED IN PROGRAMS 17,20,21,23,30,31,34,35,37,38,39,74,75,77,78,79

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
41B	FLAGWORD 3	BIT	SET	RESET
		15	NOT USED	
	GLOKFAIL	14	GIMBAL LOCK HAS OCCURRED	NOT IN GIMBAL LOCK
	REFSMFLG	13	REFSMMAT GOOD	REFSMMAT NO GOOD
	LUNAFLAG	12	LUNAR LAT-LONG	EARTH LAT-LONG
	P22MKFLG	11	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	VFLAG	10	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	ONMONFLG	9	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	PRECIFLG	8	CSMPREC OR LEMPREC CALLED INTEGRATION INITIALIZATION	INTEGRV OR INTEGRVS CALLED INTEGRATION INITIALIZATION
	CULTFLAG	7	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	ORBWFLAG	6	W MATRIX VALID FOR ORBITAL INTEGRATION	W MATRIX INVALID FOR ORBITAL INTEGRATION
	STATEFLG	5	PERMANENT STATE VECTOR UPDATED	PERMANENT STATE VECTOR NOT UPDATED
	INTYPFLG	4	CONIC INTEGRATION	ENCKE INTEGRATION
	VINTFLAG	3	CSM STATE VECTOR BEING INTEGRATED	LM STATE VECTOR BEING INTEGRATED
	D6OR9FLG	2	DIMENSION OF W IS 9 FOR INTEGRATION	DIMENSION OF W IS 6 FOR INTEGRATION
	DIMØFLAG	1	W MATRIX IS TO BE USED	W MATRIX IS NOT TO BE USED
42A	FLAGWORD 4	BIT	SET	RESET
	MRKIDFLG	15	MARK DISPLAY IN ENDIDLE	NO MARK DISPLAY IN ENDIDLE
	PRIODFLG	14	PRIORITY DISPLAY IN ENDIDLE	NO PRIORITY DISPLAY IN ENDIDLE
	NRMIDFLG	13	NORMAL DISPLAY IN ENDIDLE	NO NORMAL DISPLAY IN ENDIDLE
	PDSPFLAG	12	CAN NOT INTERRUPT PRIORITY DISPLAY	
	MWAITFLG	11	HIGHER PRIORITY DISPLAY OPERATING WHEN MARK DISPLAY INITIATED	NO HIGHER PRIORITY DISPLAY OPERATING WHEN MARK DISPLAY INITIATED
	NWAITFLG	10	HIGHER PRIORITY DISPLAY OPERATING WHEN NORMAL DISPLAY INITIATED	NO HIGHER PRIORITY DISPLAY OPERATING WHEN NORMAL DISPLAY INITIATED
	MRKNVFLG	9	ASTRONAUT USING KEYBOARD WHEN MARK DISPLAY INITIATED	ASTRONAUT NOT USING KEYBOARD WHEN MARK DISPLAY INITIATED
	NRMNVFLG	8	ASTRONAUT USING KEYBOARD WHEN NORMAL DISPLAY INITIATED	ASTRONAUT NOT USING KEYBOARD WHEN NORMAL DISPLAY INITIATED
	PRONVFLG	7	ASTRONAUT USING KEYBOARD WHEN PRIORITY DISPLAY INITIATED	ASTRONAUT NOT USING KEYBOARD WHEN PRIORITY DISPLAY INITIATED
	PINBRFLG	6	ASTRONAUT HAS INTERFERED WITH EXISTING DISPLAY	ASTRONAUT HAS NOT INTERFERED WITH EXISTING DISPLAY
	MRUPTFLG	5	MARK DISPLAY INTERRUPTED BY PRIORITY DISPLAY	MARK DISPLAY NOT INTERRUPTED BY PRIORITY DISPLAY
	NRUPTFLG	4	NORMAL DISPLAY INTERRUPTED BY PRIORITY OR MARK DISPLAY	NORMAL DISPLAY NOT INTERRUPTED BY PRIORITY OR MARK DISPLAY

TRANSMITTED IN PROGRAMS 17,20,21,23,30,31,34,35,37,38,39,74,75,77,78,79

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
42A	FLAGWORD 4	BIT	SET	RESET
	MKOVFLAG	3	MARK DISPLAY OVER NORMAL	NO MARK DISPLAY OVER NORMAL
		2	NOT USED	
	XDSPFLAG	1	MARK DISPLAY NOT TO BE INTERRUPTED	
42B	FLAGWORD 5	BIT	SET	RESET
	DSKYFLAG	15	DISPLAYS SENT TO DSKY	NO DISPLAYS TO DSKY
		14	NOT USED	
		13	NOT USED	
	V59FLAG	12	CALIBRATING FOR P23	NORMAL MARKING FOR P23
	INCORFLG	11	FIRST INCORPORATION	SECOND INCORPORATION
	PRFTRKAT	10	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	DMENFLG	9	DIMENSION OF W IS 9 FOR INCORPORATION	DIMENSION OF W IS 6 FOR INCORPORATION
	COMPUTER	8	COMPUTER IS CMC	COMPUTER IS LGC
	ENGONFLG	7	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	3AXISFLG	6	MANEUVER SPECIFIED BY THREE AXES	MANEUVER SPECIFIED BY ONE AXIS
	GRRBKFLG	5	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	R60FLAG	4	R61 MUST USE R6Ø	NORMAL R61
	SOLNSW	3	LAMBERT CONVERGES	LAMBERT DOES NOT CONVERGE
	MGLVFLAG	2	LOCAL VERTICAL COORDINATES COMPUTED	MIDDLE GIMBAL ANGLE COMPUTED
	RENDWFLG	1	W MATRIX VALID FOR RENDEZVOUS NAVIGATION	W MATRIX INVALID FOR RENDEZVOUS NAVIGATION
43A	FLAGWORD 6	BIT	SET	RESET
	DAPBIT1, DAPBIT2	15	0 } NO DAP OR 0 } ENTRY; 0 } CSM RCS 1 } DAP	1 } TVC DAP; 1 } SATURN DAP
		14		
	ENTRYDSP	13	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	CMDAPARM	12	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	GAMDIFSW	11	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	GONEPAST	10	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	RELVELSW	9	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	EGSW	8	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	R57FLAG	8	DO NOT DO R57, TRUNNION BIAS HAS OBTAINED	DO R57, TRUNNION BIAS NEEDED
	FIRSTPAS	7	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	HIND	6	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	INRLSW	5	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	LATSW	4	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	NTARGFLG	3	ASTRONAUT DID OVERWRITE DELTA	ASTRONAUT DID NOT OVERWRITE DELTA
	CM/DSTBY	2	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	GYMDIFSW	1	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
43B	FLAGWORD 7	BIT	SET	RESET
	TERMIFLG	15	TERMINATE R21, R22	DO NOT TERMINATE R21, R22
	ITSWICH	14	ACCEPT NEXT LAMBERT TPI SEARCH SOLUTION	TEST LAMBERT ANSWER AGAINST LIMITS

RENDEZVOUS AND PRETHRUST - Continued

TRANSMITTED IN PROGRAMS 17,20,21,23,30,31,34,35,37,38,39,74,75,77,78,79

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
42A	FLAGWORD 4	BIT	SET	RESET
	MKOVFLAG	3	MARK DISPLAY OVER NORMAL	NO MARK DISPLAY OVER NORMAL
		2	NOT USED	
	XDSPFLAG	1	MARK DISPLAY NOT TO BE INTERRUPTED	
42B	FLAGWORD 5	BIT	SET	RESET
	DSKYFLAG	15	DISPLAYS SENT TO DSKY	NO DISPLAYS TO DSKY
		14	NOT USED	
		13	NOT USED	
	V59FLAG	12	CALIBRATING FOR P23	NORMAL MARKING FOR P23
	INCORFLG	11	FIRST INCORPORATION	SECOND INCORPORATION
	PRFTRKAT	10	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	DMENFLG	9	DIMENSION OF W IS 9 FOR INCORPORATION	DIMENSION OF W IS 6 FOR INCORPORATION
	COMPUTER	8	COMPUTER IS CMC	COMPUTER IS LGC
	ENGONFLG	7	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	3AXISFLG	6	MANEUVER SPECIFIED BY THREE AXES	MANEUVER SPECIFIED BY ONE AXIS
	GRRBKFLG	5	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	R60FLAG	4	R61 MUST USE R6Ø	NORMAL R61
	SOLNSW	3	LAMBERT CONVERGES	LAMBERT DOES NOT CONVERGE
	MGLVFLAG	2	LOCAL VERTICAL COORDINATES COMPUTED	MIDDLE GIMBAL ANGLE COMPUTED
	RENDWFLG	1	W MATRIX VALID FOR RENDEZVOUS NAVIGATION	W MATRIX INVALID FOR RENDEZVOUS NAVIGATION
43A	FLAGWORD 6	BIT	SET	RESET
	DAPBIT1, DAPBIT2	15	0 NO DAP OR 0 ENTRY; 0 CSM RCS 1 DAP	1 TVC DAP; 1 SATURN DAP
		14		
	ENTRYDSP	13	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	CMDAPARM	12	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	GAMDIFSW	11	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	GONEPAST	10	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	RELVELSW	9	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	EGSW	8	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	R57FLAG	8	DO NOT DO R57, TRUNNION BIAS HAS OBTAINED	DO R57, TRUNNION BIAS NEEDED
	FIRSTPAS	7	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	HIND	6	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	INRLSW	5	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	LATSW	4	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	NTARGFLG	3	ASTRONAUT DID OVERWRITE DELTA	ASTRONAUT DID NOT OVERWRITE DELTA
	CM/DSTBY	2	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	GYMDIFSW	1	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
43B	FLAGWORD 7	BIT	SET	RESET
	TERMIFLG	15	TERMINATE R21, R22	DO NOT TERMINATE R21, R22
	ITSWICH	14	ACCEPT NEXT LAMBERT TPI SEARCH SOLUTION	TEST LAMBERT ANSWER AGAINST LIMITS

RENDEZVOUS AND PRETHRUST - Continued

TRANSMITTED IN PROGRAMS 17,20,21,23,30,31,34,35,37,38,39,74,75,77,78,79

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
43B	FLAGWORD 7	BIT	SET	RESET
	IGNFLAG	13	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	ASTNFLAG	12	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	TIMRFLAG	11	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	NORMSW	10	UNIT NORMAL COMPUTED	UNIT NORMAL NOT COMPUTED
	RVSW	9	COMPUTE STATE VECTOR DURING TIME - THETA	DO NOT COMPUTE STATE VECTOR
	GONEBY	8	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	IDLEFLAG	7	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	V37FLAG	6	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	NOUPFLAG	5	NEITHER CSM NOR LM STATE VECTOR MAY BE UPDATED	EITHER STATE VECTOR MAY BE UPDATED
	UPLOCKFL	4	K-$\overline{K}$-K FAIL	NO K-$\overline{K}$-K FAIL
	VERIFLAG	3	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	ATTCHFLG	2	LM, CM ATTACHED	LM, CM NOT ATTACHED
	TFFSW	1	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
44A	FLAGWORD 8	BIT	SET	RESET
	RPQFLAG	15	RPQ NOT COMPUTED	RPQ COMPUTED
		14	NOT USED	
	NEWIFLG	13	FIRST PASS THROUGH INTEGRATION	SUCCEEDING ITERATION OF INTEGRATION
	CMOONFLG	12	PERMANENT CSM STATE IN LUNAR SPHERE	PERMANENT CSM STATE IN EARTH SPHERE
	LMOONFLG	11	PERMANENT LM STATE IN LUNAR SPHERE	PERMANENT LM STATE IN EARTH SPHERE
	ADVTRK	10	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	P37/79SW	9	P37/79 OPERATING	P38/78 OPERATING
	SURFFLAG	8	LM ON LUNAR SURFACE	LM NOT ON LUNAR SURFACE
	INFINFLG	7	TIMETHET SOLUTION EXIST	TIMETHET SOLUTION DOES NOT EXIST
	ORDERSW	6	1ST ORDER ITERATOR	2ND ORDER ITERATOR
	APSESW	5	NOMINAL TIMERAD SOLUTION	OFF-NOMINAL TIMERAD SOLUTION
	COGAFLAG	4	TIMETHET SOLUTION EXISTS	NO TIMETHET SOLUTION EXISTS
		3	NOT USED	
		2	NOT USED	
	360SW	1	TRANSFER ANGLE NEAR 360 DEGREES	TRANSFER ANGLE NOT NEAR 360 DEGREES
44B	FLAGWORD 9	BIT	SET	RESET
	SWTOVER	15	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	V67FLAG	14	NOT USED IN RENDEZVOUS AND PRETHRUST LIST	
	V82EMFLG	13	MOON VICINITY	EARTH VICINITY
	MAXDBFLG	12	MAX DB SELECTED	MAX DB NOT SELECTED
	V94FLAG	11	V94 ALLOWED DURING P23	V94 NOT ALLOWED
	SAVECFLG	10	P23 DISPLAY AND DATA STORAGE AFTER MARK IS DONE	P23 DISPLAY AND DATA STORAGE BEFORE MARK IS DONE
	VHFRFLAG	9	ALLOW R22 TO ACCEPT RANGE DATA	STOP ACCEPTANCE OF RANGE DATA
	SOURCFLG	8	SOURCE OF INPUT DATA IS FROM VHF RADAR	SOURCE OF DATA IS FROM OPTICS MARK
		7	NOT USED	

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
44B	FLAGWORD 9	BIT	SET	RESET
	N220RN17	6	COMPUTE TOTAL ATTITUDE ERRORS WRT N22 (V62)	COMPUTE TOTAL ATTITUDE ERRORS WRT N17 (V63)
	QUITFLAG	5	CAUSE INTEGRATION TO EXIT AT NEXT TIME STEP	ALLOW INTEGRATION TO CONTINUE
	R31FLAG	4	R31 SELECTED (V83)	R34 SELECTED (V85)
	MID1FLAG	3	INTEGRATE TO TDEC	INTEGRATE TO THE THEN-PRESENT TIME
	MIDAVFLG	2	INTEGRATION ENTERED FROM ONE OF MIDTOAV PORTALS	INTEGRATION WAS NOT ENTERED VIA MIDTOAV
	AVEMIDSW	1	AVETOMID CALLING FOR W MATRIX INTEGER DO NOT WRITE OVER RN, VN, PIPTIME	NO AVETOMID W INTEGER ALLOW SET UP OF RN, VN, PIPTIME
45A	DSPTAB	DISPLAY TABLE CODES FOR GENERATION OF DSKY NUMERICS		
45B	DSPTAB + 1			
46A	DSPTAB + 2			
46B	DSPTAB + 3			
47A	DSPTAB + 4	USED TO INDICATE VERB-NOUN, MAJOR MODE AND R_1 R_2 R_3 DISPLAYS.		
47B	DSPTAB + 5			
48A	DSPTAB + 6			
48B	DSPTAB + 7			
49A	DSPTAB + 8			
49B	DSPTAB + 9			
50A	DSPTAB + 10			
50B	DSPTAB + 11	DISPLAY TABLE OF DSKY STATUS LIMITS 60400_8 = PROGRAM CAUTION, 60200_8 = TRACKER WARNING 60020_8 = NO ATTITUDE, 60040_8 = GIMBAL LOCK		
51A 51B	TIME2, TIME1	COMPUTER CLOCK INDICATING ELAPSED TIME SINCE LIFTOFF		
52A 52B	R_X X COMPONENT OF "OTHER" VEHICLE POSITION	"OTHER" VEHICLE STATE VECTOR		
53A 53B	R_Y Y COMPONENT OF "OTHER" VEHICLE POSITION			
54A 54B	R_Z Z COMPONENT OF "OTHER" VEHICLE POSITION			
55A 55B	V_X X COMPONENT OF "OTHER" VEHICLE VELOCITY			
56A 56B	V_Y Y COMPONENT OF "OTHER" VEHICLE VELOCITY			
57A 57B	V_Z Z COMPONENT OF "OTHER" VEHICLE VELOCITY			
58A 58B	T_{OTHER} TIME TAG FOR "OTHER" STATE VECTOR			
59A	CDUX	SAME AS 9A		
59B	CDUY	SAME AS 9B		
60A	CDUZ	SAME AS 10A		
60B	CDUT	SAME AS 10B		
61A 61B	$ADOT_X$	SAME AS 11A, 11B		

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
62A 62B 63A 63B	$ADOT_Y$ $ADOT_Z$	SAME AS 12A, 12B SAME AS 13A, 13B
64A 64B 65A	AK AK1 AK2	SAME AS 14A SAME AS 14B SAME AS 15A
65B	RCSFLAGS	SAME AS 15B
66A 66B 67A	$THETAD_X$ $THETAD_Y$ $THETAD_Z$	SAME AS 16A SAME AS 16B SAME AS 17A
67B	$DELCDU_X$	SAME AS 17B
68A 68B	RSBBQ + 1	VALUE OF BBANK AND Q REGISTERS AT THE TIME OF A RESTART
69A	CADRFLSH	VALUE OF RETURN ADDRESS INFORMATION FOR LAST REQUESTED PRIORITY DISPLAY
69B	CADRFLSH + 1	VALUE OF RETURN ADDRESS INFORMATION FOR LAST REQUESTED MARK
70A	CADRFLSH + 2	VALUE OF RETURN ADDRESS INFORMATION FOR LAST NORMAL DISPLAY REQUESTED
70B 71A 71B	FAILREG FAILREG + 1 FAILREG + 2	CONTAINS ALARM CODE OF FIRST ALARM RECEIVED CONTAINS ALARM CODE OF SECOND ALARM RECEIVED CONTAINS ALARM CODE OF THIRD ALARM RECEIVED
72A	CDUS	SHAFT CDU INPUT COUNTER
72B 73A 73B	PIPAX PIPAY PIPAZ	X, Y, AND Z PIPA INPUT COUNTERS. ZEROED AT THE START OF AVERAGE G READ EVERY 2 SEC DURING AVERAGE G ROUTINE
74A 74B	ELEV	DESIRED LOS ANGLE AT TPI
75A 75B	CENTANG	ORBITAL CENTRAL ANGLE OF THE PASSIVE VEHICLE DURING TRANSFER FROM TPI TO TIME OF INTERCEPT
76A 76B	DELTAR	THE DESIRED SEPARATION OF THE TWO VEHICLES SPECIFIED AS A DISTANCE ALONG THE PASSIVE VEHICLE ORBIT

TRANSMITTED IN PROGRAMS 17,20,21,23,30,31,34,35,37,38,39,74,75,77,78,79

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
77A 77B 78A 78B 79A 79B	DELVEET3X DELVEET3Y DELVEET3Z	X, Y, AND Z COMPONENTS OF DELTA VELOCITY REQUIRED TO COMPLETE MANEUVER
80A	OPTMODES	

BIT	SET	RESET
15	NOT ASSIGNED - SHOULD BE ZERO	
14	NOT ASSIGNED - SHOULD BE ZERO	
13	NOT ASSIGNED - SHOULD BE ZERO	
12	NOT ASSIGNED - SHOULD BE ZERO	
11	NOT ASSIGNED - SHOULD BE ZERO	
10	INDICATES OPTICS HAS BEEN ZEROED SINCE LAST FRESH START	ALARM 120_8 WILL BE GENERATED IF ATTEMPT IS MADE TO ZERO OPTICS
9	OPTICS MODE SWITCH IN COMPUTER POSITION	RESET BY FRESH START OR MODE OTHER THAN CMC
8	NOT ASSIGNED - SHOULD BE ZERO	
7	OPTICS CDU FAIL PRESENT	NO OPTICS CDU FAIL PRESENT
6	NOT ASSIGNED - SHOULD BE ZERO	
5	OPTICS MODE SWITCH NOT IN CMC POSITION	OPTICS MODE SWITCH IN CMC POSITION
4	OPTICS ZERO SWITCH NOT IN ZERO POSITION	OPTICS ZERO SWITCH IN ZERO POSITION
	(BIT 4, 5 = 1'S OPTICS MANUAL MODE)	
3	NOT ASSIGNED - SHOULD BE ZERO	
2	NOT ASSIGNED - SHOULD BE ZERO	
1	NOT ASSIGNED - SHOULD BE ZERO	

80B	HOLDFLAG	USED TO DETERMINE NATURE OF ATTITUDE HOLD CONTROL IN CMS RCS DAP. IF >+0 PERFORM ATTITUDE HOLD ABOUT ANGLES CONTAINED IN CDU INPUT COUNTERS (PRESENT IMU ANGLES). IF = +0 PERFORM ATTITUDE HOLD ABOUT EXISTING REFERENCE. IF <+0 AUTOMATIC STEERING IS TO BE PERFORMED.
81A 81B	LEMMASS CSMMASS	MASS OF THE LEM MASS OF THE CSM
82A	DAPDATR1 LOADED WITH V48N46E	

BITS							
15	NOT USED - SHOULD BE ZERO						
14	0 NO DAP	0 LM OFF RCS DAP	1 LM ON RCS DAP	1 SATURN DAP			
13	0 NO DAP	1 LM OFF RCS DAP	0 LM ON RCS DAP	1 SATURN DAP			
12	NOT USED - SHOULD BE ZERO						
11	NOT USED - SHOULD BE ZERO						
9	NOT USED - SHOULD BE ZERO						
8	NOT USED - SHOULD BE ZERO						
10	X TRANSLATION 0 1 OR USES 0 1	AC AND BD QUADS	0 USE AC QUAD 1	1 USE BD QUAD 0			
7							

TRANSMITTED IN PROGRAMS 17,20,21,23,30,31,34,35,37,38,39,74,75,77,78,79

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
82A	DAPDATR1	BITS 6 NOT USED - SHOULD BE ZERO 5 NOT USED - SHOULD BE ZERO 4 ANGULAR DEADBAND FOR ATTITUDE HOLD AND AUTOMATIC MANEUVERS 0 - ±0.5° DEADBAND 1 - ±5.0° DEADBAND 3 NOT USED - SHOULD BE ZERO 2 SPECIFY MANEUVER RATE 0 0 .05° / SEC; 1 0 .2° / SEC; 0 1 .5° / SEC; 1 1 4.0° / SEC
82B	DAPDATR2	BITS 15-14 NOT USED - SHOULD BE ZERO 13 ROLL JET SELECTION 0 - USE QUAD AC FOR ROLL MANEUVERS 1 - USE QUAD BD FOR ROLL MANEUVERS 12-11 NOT USED - SHOULD BE ZERO 10 A QUAD FAIL 0 - QUAD A IS OK 1 - QUAD A FAILED 9-8 NOT USED - SHOULD BE ZERO 7 B QUAD FAIL 0 - QUAD B IS OK 1 - QUAD B FAILED 6-5 NOT USED - SHOULD BE ZERO 4 C QUAD FAIL 0 - QUAD C IS OK 1 - QUAD C FAILED 3-2 NOT USED - SHOULD BE ZERO 1 D QUAD FAIL 0 - QUAD D IS OK 1 - QUAD D FAILED
83A 83B 84A	$ERROR_X$ $ERROR_Y$ $ERROR_Z$	INTERMEDIATE ATTITUDE ERRORS COMPUTED DURING CSM RCS (DAP FOLLOWING ERRORS). ERRORS IN CONTROL COORDINATES AND ARE LOADED INTO AK'S FOR FDAI DISPLAY WHEN FW0 BIT 9 = 0.
84B	THETADX	SAME AS 16A
85A 85B	WBODY	DESIRED BODY ROLL RATE ABOUT CONTROL AXIS
86A 86B	WBODY1	DESIRED BODY PITCH RATE ABOUT CONTROL AXIS
87A 87B	WBODY2	DESIRED BODY YAW RATE ABOUT CONTROL AXIS
88A	REDOCTR	INDICATES THE NUMBER OF RESTARTS WHICH HAVE OCCURRED SINCE LAST FRESH START

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
88B	THETAD	FINAL DESIRED X CDU ANGLE		
89A	THETAD + 1	FINAL DESIRED Y CDU ANGLE		
89B	THETAD + 2	FINAL DESIRED Z CDU ANGLE		
90A	IMODES30	BIT	SET	RESET
		15	IMU TEMPERATURE OUT OF LIMITS	IMU TEMPERATURE WITHIN LIMITS
		14	NO ISS TURN ON REQUEST PRESENT	ISS TURN ON REQUEST PRESENT
		13	NO IMU FAIL	IMU FAIL HAS OCCURRED
		12	NO ICDU FAIL	ICDU FAIL HAS OCCURRED
		11	NO IMU CAGE COMMANDED	IMU CAGE HAS BEEN COMMANDED
		10	NO PIPA FAIL	PIPA FAIL HAS OCCURRED
		9	IMU NOT OPERATING	IMU OPERATING
		8	USED IN IMU TURN-ON	SEQUENCING MOST LIKELY ZERO
		7	SAME AS BIT 8	
		6	IMU INITIALIZATION BEING ACCOMPLISHED	IMU NOT IN INITIALIZATION
		5	INHIBIT ALARM 212_8 IF PIPA FAIL OCCURS	DO NOT INHIBIT ALARM 212_8 IF PIPA FAIL OCCURS
		4	INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF IMU FAIL OCCURS	DO NOT INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF IMU FAIL OCCURS
		3	INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF ICDU FAIL OCCURS	DO NOT INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF ICDU FAIL OCCURS
		2	TURN-ON DELAY FAILURE (ALARM 207_8)	NO TURN-ON DELAY FAILURE
		1	INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF A PIPA FAIL OCCURS	DO NOT INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF A PIPA FAIL OCCURS
90B	IMODES33	BIT	SET	RESET
		15	NOT ASSIGNED - SHOULD BE ZERO	
		14	NOT ASSIGNED - SHOULD BE ZERO	
		13	PIPA FAIL HAS NOT OCCURRED	PIPA FAIL HAS OCCURRED
		12	TELEMETRY DOWNLINK OK	TELEMETRY DOWNLINK IS TOO FAST
		11	UPLINK IS OK	UPLINK IS TOO FAST
		10	NOT ASSIGNED - SHOULD BE ZERO	
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NOT ASSIGNED - SHOULD BE ZERO	
		6	IMU IN COARSE ALIGN OR ZEROING MODE	IMU NOT IN COARSE ALIGN OR ZEROING MODE
		5	IMU IN ZEROING ROUTINE	IMU NOT IN ZEROING ROUTINE
		4	NOT ASSIGNED - SHOULD BE ZERO	
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	NOT USED	
		1	LAMP TEST IN PROGRESS (V35)	LAMP TEST NOT IN PROGRESS

TRANSMITTED IN PROGRAMS 17,20,21,23,30,31,34,35,37,38,39,74,75,77,78,79

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
91A	CHANNEL 11	BIT	SET	RESET
		15	NOT ASSIGNED - SHOULD BE ZERO	
		14	NOT ASSIGNED - SHOULD BE ZERO	
		13	SPS ENGINE ON COMMAND	
		12	NOT ASSIGNED - SHOULD BE ZERO	
		11	NOT ASSIGNED - SHOULD BE ZERO	
		10	ERROR RESET KEYCODE RECEIVED FROM UPLINK ON DSKY	
		9	INDICATES AVERAGE G ROUTINE IS RUNNING	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	OPERATOR ERROR HAS OCCURRED	
		6	VERB-NOUN FLASHER ON	
		5	KEY RELEASE LAMP ON	
		4	IMU TEMPERATURE IS OUT OF LIMITS	
		3	UPLINK ACTIVITY LAMP ON	
		2	COMPUTER ACTIVITY LAMP ON	
		1	ISS WARNING LAMP ON	
91B	CHANNEL 12	BIT	SET	RESET
		15	TURN ON DELAY - COMPLETE	
		14	S-IVB CUTOFF COMMAND	
		13	S-IVB INJECTION SEQUENCING START	
		12	NOT ASSIGNED - SHOULD BE ZERO	
		11	DISENGAGE OPTICS DAC	
		10	ZERO OPTICS COMMAND	
		9	S-IVB TAKEOVER ENABLE	
		8	TVC ENABLE	
		7	NOT ASSIGNED - SHOULD BE ZERO	
		6	IMU CDU ERROR COUNTER ENABLE	
		5	IMU CDU ZERO COMMAND	
		4	IMU COARSE ALIGN ENABLE	
		3	STAR TRACKERS ON	
		2	OPTICS CDU ERROR COUNTER ENABLE	
		1	OPTICS CDU ZERO COMMAND	
92A	CHANNEL 13	BIT	SET	RESET
		15	T6RUPT ENABLE	
		14	RESET TRAP 32	
		13	RESET TRAP 31-B	
		12	RESET TRAP 31-A	
		11	ENABLE STANDBY BUTTON	
		10	LAMP TEST BEING PERFORMED	
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	BMAG OUTPUT ENABLE	
		7	WORD ORDER CODE FOR WORDS 2-50, 52-100	WORD ORDER CODE FOR WORDS 1 AND 51

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
92A	CHANNEL 13	BIT	SET	RESET
		6	BLOCK UPLINK	
		5	INHIBIT UPLINK	ENABLE CROSSLINK
		4	RANGE UNIT ACTIVITY	
		3	RANGE UNIT SELECT a	
		2	RANGE UNIT SELECT b	
		1	RANGE UNIT SELECT c	
92B	CHANNEL 14	BIT	SET	RESET
		15	XCDU DRIVE ENABLE	
		14	YCDU DRIVE ENABLE	
		13	ZCDU DRIVE ENABLE	
		12	TRUNNION CDU DRIVE ENABLE	
		11	SHAFT CDU DRIVE ENABLE	
		10	GYRO TORQUING ENABLE	
		9	NEGATIVE GYRO TORQUE	POSITIVE GYRO TORQUE
		8 7	GYRO SELECT 0 0 } NO GYRO 0 0 } X GYRO 1 0 } Y GYRO 1 1 } Z GYRO	
		6	GYRO PULSE TORQUE POWER SUPPLY ENABLED	
		5	NOT USED - SHOULD BE ZERO	
		4	NOT ASSIGNED - SHOULD BE ZERO	
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	NOT ASSIGNED - SHOULD BE ZERO	
		1	NOT USED - SHOULD BE ZERO	
93A	CHANNEL 30	BIT	SET	RESET
		15	IMU TEMPERATURE OUT OF LIMITS	IMU TEMPERATURE WITHIN LIMITS
		14	ISS OFF	ISS ON OR COMMANDED ON
		13	NO IMU FAIL	IMU FAILURE
		12	NO ICDU FAIL	ICDU FAILURE
		11	NO IMU CAGE COMMANDED	IMU CAGE COMMANDED
		10		LAUNCH VEHICLE GUIDANCE SWITCH IN CMC POSITION
		9	IMU NOT OPERATING	IMU OPERATING
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NO OCDU FAIL	OCDU FAILURE
		6	NOT USED	
		5	LIFTOFF HAS NOT OCCURRED	LIFTOFF HAS OCCURRED
		4	S-IVB ATTACHED	S-IVB SEPARATED
		3	SPS NOT READY	SPS READY
		2	CM/SM ATTACHED	CM/SM SEPARATED
		1	ULLAGE THRUST NOT PRESENT FOR S-IVB	ULLAGE THRUST PRESENT FOR S-IVB
93B	CHANNEL 31	BIT	SET	RESET
		15	COMPUTER NOT IN CONTROL OF SPACECRAFT	COMPUTER IN CONTROL OF SPACECRAFT
		14 13	CSM RCS DAP MODE 0 0 } ILLEGAL 0 1 } FREE MODE 1 0 } HOLD MODE 1 1 } AUTO MODE	

TRANSMITTED IN PROGRAMS 17,20,21,23,30,31,34,35,37,38,39,74,75,77,78,79

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
93B	CHANNEL 31	BIT	SET	RESET
	THC INPUTS	12		-Z TRANSLATION COMMANDED
		11		+Z TRANSLATION COMMANDED
		10		-Y TRANSLATION COMMANDED
		9		+Y TRANSLATION COMMANDED
		8		-X TRANSLATION COMMANDED
		7		+X TRANSLATION COMMANDED
	RHC INPUTS	6		-ROLL COMMANDED
		5		+ROLL COMMANDED
		4		-YAW COMMANDED
		3		+YAW COMMANDED
		2		-PITCH COMMANDED
		1		+PITCH COMMANDED
94A	CHANNEL 32	BIT	SET	RESET
		15	NOT ASSIGNED - SHOULD BE ZERO	
		14		PROCEED KEY IS DEPRESSED
		13	NOT ASSIGNED - SHOULD BE ZERO	
		12	NOT ASSIGNED - SHOULD BE ZERO	
		11		LM ATTACHED
		10	NOT ASSIGNED - SHOULD BE ZERO	
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NOT ASSIGNED - SHOULD BE ZERO	
	MINIMUM IMPULSE CONTROLLER INPUTS	6		-ROLL COMMANDED
		5		+ROLL COMMANDED
		4		-YAW COMMANDED
		3		+YAW COMMANDED
		2		-PITCH COMMANDED
		1		+PITCH COMMANDED
94B	CHANNEL 33	BIT	SET	RESET
		15		COMPUTER OSCILLATOR HAS FAILED
		14		CMC WARNING HAS OCCURRED
		13		PIPA FAIL HAS OCCURRED
		12		TELEMETRY DOWNLINK IS TOO FAST
		11		UPLINK IS TOO FAST
		10	BLOCK UPLINK SWITCH IN NORMAL POSITION	BLOCK UPLINK SWITCH IN BLOCK POSITION
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NOT ASSIGNED - SHOULD BE ZERO	
		6	NOT ASSIGNED - SHOULD BE ZERO	
		5	OPTICS MODE SWITCH IN MANUAL POSITION	OPTICS MODE SWITCH IN COMPUTER POSITION
		4	OPTICS ZERO SWITCH IN NORMAL POSITION	OPTICS ZERO SWITCH IN ZERO POSITION
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	RANGE UNIT DATA NOT GOOD	RANGE UNIT DATA GOOD
		1	NOT ASSIGNED - SHOULD BE ZERO	

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
95A 95B	RTHETA	ANGLE BETWEEN LOCAL HORIZONTAL AND +X AXIS (NOUN 54) OR STAR LINE OF SIGHT (NOUN 53)		
96A 96B	LAT (SPL)	LATITUDE OF THE SPLASHDOWN SITE		
97A 97B	LNG (SPL)	LONGITUDE OF THE SPLASHDOWN SITE		
98A 98B	VPRED	PREDICTED VELOCITY AT ALTITUDE OF 400,000 FEET ABOVE FISCHER RADIUS		
99A 99B	GAMMAEI	VALUE OF FLIGHT PATH ANGLE AT 400,000 FEET ABOVE FISCHER RADIUS		
100A	FLAGWORD 10	BIT	SET	RESET
		15	NOT USED	
	INTFLBIT	14	INTEGRATION IN PROGRESS	INTEGRATION NOT IN PROGRESS
		13	NOT USED	
		12	NOT USED	
		11	NOT USED	
		10	NOT USED	
		9	NOT USED	
		8	NOT USED	
	REINTFLG, REINTBIT	7	INTEGRATION ROUTINE TO BE RESTARTED	INTEGRATION ROUTINE NOT TO BE RESTARTED
		6	NOT USED	
		5	NOT USED	
		4	NOT USED	
		3	NOT USED	
		2	NOT USED	
		1	NOT USED	
100B	FLAGWORD 11	BIT	SET	RESET
		NOT USED		

POWERED LIST

TRANSMITTED IN PROGRAMS 40,41,47,61

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
1A 1B	LIST ID SYNC BITS	$(77774)_8$ INDICATES POWERED LIST BEING TRANSMITTED $(77340)_8$ INDICATES DATA TO FOLLOW
2A 2B	R_X X COMPONENT OF VEHICLE POSITION VECTOR	CSM VEHICLE STATE VECTOR AND TIME
3A 3B	R_Y Y COMPONENT OF VEHICLE POSITION VECTOR	
4A 4B	R_Z Z COMPONENT OF VEHICLE POSITION VECTOR	
5A 5B	V_X X COMPONENT OF VEHICLE VELOCITY VECTOR	
6A 6B	V_Y Y COMPONENT OF VEHICLE VELOCITY VECTOR	
7A 7B	V_Z Z COMPONENT OF VEHICLE VELOCITY VECTOR	
8A 8B	T_{SV} TIME TAG FOR $\overline{R}$ AND $\overline{V}$	
9A 9B 10A	CDUX CDUY CDUZ	X, Y, AND Z CDU INPUT COUNTERS. READ THE IMU COUNTERS ZEROED DURING ZERO ENCODE MODE (IMODES 33 BIT 5 = 1)
10B	CDUT	TRUNNION CDU INPUT COUNTER

	CSM-RCS DAP ON	TVC DAP ON	CSM-RCS DAP ON	TVC DAP ON
11A 11B	ADOT$_X$	OGARATE	BODY RATE ABOUT X AXIS	OUTER GIMBAL ANGLE RATE
12A 12B	ADOTY	OMEGAYB	BODY RATE ABOUT Y AXIS	BODY AXIS PITCH RATE
13A 13B	ADOTZ	OMEGAZB	BODY RATE ABOUT Z AXIS	BODY AXIS ROLL RATE

	CSM-RCS DAP ON	TVC DAP ON	CSM-RCS DAP ON	TVC DAP ON
14A 14B 15A	AK AK2 AK3	PAXERR	VEHICLE ATTITUDE ERRORS (RPY) SENT TO FDAI. DURING RCS DAP OPERATION EITHER TOTAL ATTITUDE OR DAP FOLLOWING ERROR IS DISPLAYED (DET BY FLAGWORD 0 BIT 9)	DIFFERENCE BETWEEN DESIRED AND PRESENT CDU X PITCH ERROR SIGNAL COMPUTED IN TVC DAP. YAW ERROR SIGNAL COMPUTED IN TVC DAP.

15B	RCSFLAGS	BIT	SET	RESET
		15	NOT USED - SHOULD BE ZERO	
		14	RATE FILTER NOT INITIALIZED	RATE FILTER INITIALIZED
		13	ROLL RATE DAMPING REQUIRED	

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
15B	RCSFLAGS	BIT / SET / RESET
		12 — PITCH RATE DAMPING REQUIRED
		11 — YAW RATE DAMPING REQUIRED
		10 — -ROLL RHC INPUT
		9 — +ROLL RHC INPUT
		8 — -YAW RHC INPUT
		7 — +YAW RHC INPUT
		6 — -PITCH RHC INPUT
		5 — +PITCH RHC INPUT
		4 — COMPUTE AK'S (ATTITUDE ERRORS) / PERFORM NEEDLER TO DISPLAY AK'S
		3, 2 — 0 0 = 3RD PASS THROUGH NEEDLER; 0 1 = 2ND PASS THROUGH NEEDLER; 1 1 = INITIAL PASS THROUGH NEEDLER
		1 — INITIALIZE T_6 PROGRAM
16A 16B 17A	$THETAD_X$ $THETAD_Y$ $THETAD_Z$	X, Y, AND Z REFERENCE CDU ANGLES FOR THE ATTITUDE HOLD ROUTINE. INTERMEDIATE DESIRED CDU ANGLES FOR AUTO MANEUVER ROUTINE.
17B	$DELCDU_X$	MOST SIGNIFICANT HALF OF X INCREMENTAL GIMBAL ANGLE USED IN AUTOMATIC MANEUVERS
18A 18B	TIG	TIME OF IGNITION
19A 19B	DELLT4	TIME REMAINING UNTIL ARRIVAL AT AIMPOINT
20A 20B	$RTARG_X$	X COMPONENT OF TARGET POSITION VECTOR
21A 21B	$RTARG_Y$	Y COMPONENT OF TARGET POSITION VECTOR
22A 22B	$RTARG_Z$	Z COMPONENT OF TARGET POSITION VECTOR
23A 23B	TGO	TIME TO GO TO ENGINE CUTOFF
24A 24B	PIPTIME1	THE TIME AT WHICH PIPA'S WERE LAST READ
25A 25B	$DELV_X$	X, Y, AND Z PIPA VALUES AT LAST READING CORRECTED FOR SCALE FACTOR ERROR AND BIAS. DURING AVERAGE G ROUTINE THEY ARE READ EVERY 2 SECONDS.
26A 26B	$DELV_Y$	
27A 27B	$DELV_Z$	

POWERED LIST - Continued

TRANSMITTED IN PROGRAMS 40,41,47,61

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
28A	PACTOFF	VALUE OF PITCH TRIM ANGLE FOR SPS ENGINE DURING TVC DAP
28B	YACTOFF	VALUE OF YAW TRIM ANGLE FOR SPS ENGINE DURING TVC DAP
29A	PCMD	VALUE SENT TO OCDU FOR SPS PITCH GIMBAL TRIM DURING TVC DAP
29B	YCMD	VALUE SENT TO OCDU FOR SPS YAW GIMBAL TRIM DURING TVC DAP
30A	CSTEER	CROSS PRODUCT STEERING CONSTANT
30B	ALP	UPCONTROL CONSTANT
31A 31B 32A 32B 33A 33B	SPARES	
34A 34B	X_X	REFSMAT
35A 35B	X_Y	
36A 36B	X_Z	
37A 37B	Y_X	
38A 38B	Y_Y	
39A 39B	Y_Z	

40A	FLAGWORD 0	BIT	SET	RESET
	CPHIFLAG	15	OUTPUT OF CALCGA IS CPHIX	OUTPUT OF CALCGA IS THETAD
	JSWITCH	14	NOT USED IN POWERED LIST	
	MIDFLAG	13	NOT USED IN POWERED LIST	
	MOONFLAG	12	NOT USED IN POWERED LIST	
	NORFHOR	11	NOT USED IN POWERED LIST	
	ZMEASURE	10	NOT USED IN POWERED LIST	
	NEEDLFLG	9	TOTAL ALTITUDE ERROR DISPLAYED	A/P FOLLOWING ERROR DISPLAYED
	IMUSE	8	IMU IN USE	IMU NOT IN USE
	RNDVZFLG	7	NOT USED IN POWERED LIST	
	R53FLAG	6	NOT USED IN POWERED LIST	
	F2RTE	5	NOT USED IN POWERED LIST	
	TRUNFLAG	4	NOT USED IN POWERED LIST	
	FREEFLAG	3	NOT USED IN POWERED LIST	
	B29FLAG	2	NOT USED	
	KFLAG	1	NOT USED IN POWERED LIST	

POWERED LIST - Continued

TRANSMITTED IN PROGRAMS 40,41,47,61

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
40B	FLAGWORD 1	BIT	SET	RESET
	NJETSFLG	15	TWO JET RCS BURN	FOUR JET RCS BURN
	STIKFLAG	14	RHC CONTROL OF RCS	CMC CONTROL OF RCS
	ERADFLAG	13	NOT USED IN POWERED LIST	
		12	NOT USED	
	ENG2FLAG	11	RCS BURN	SPS BURN
	TARG1FLG	10	NOT USED IN POWERED LIST	
	TARG2FLG	9	NOT USED IN POWERED LIST	
	R23FLG	9	NOT USED IN POWERED LIST	
	VEHUPFLG	8	NOT USED IN POWERED LIST	
	UPDATFLG	7	NOT USED IN POWERED LIST	
	IDLEFAIL	6	INHIBIT R41	ENABLE R41 (ENGFAIL) THRUST NOT DETECTED
	TRACKFLG	5	NOT USED IN POWERED LIST	
		4	NOT USED	
	SLOPESW	3	NOT USED IN POWERED LIST	
	GUESSW	2	NOT USED IN POWERED LIST	
	AVEGFLAG	1	AVERAGE G (SERVICER) TO CONTINUE	AVERAGE G (SERVICER) TO CEASE
41A	FLAGWORD 2	BIT	SET	RESET
	DRIFTFLG	15	T3RUPT CALLS GYRO COMPENSATION	T3RUPT DOES NO GYRO COMPENSATION
	R21MARK	14	NOT USED IN POWERED LIST	
	22DSPFLG	13	NOT USED IN POWERED LIST	
		12	NOT USED	
	STERRSW	11	STEERING TO BE DONE	STEERING OMITTED
	CYCLESW	10	VG CALCULATION TO BE DONE	VG CALCULATION OMITTED
	IMPULSW	9	MINIMUM IMPULSE BURN (CUTOFF TIME SPECIFIED)	STEERING BURN (NO CUTOFF TIME YET AVAILABLE)
	XDELVFLG	8	EXTERNAL DELTAV VG COMPUTATION	LAMBERT (AIMPOINT) VG COMPUTATION
	FIRSTFLG	7	SUCCEEDING PASS THRU S40.9	FIRST PASS THRU S40.9
	FINALFLG	6	NOT USED IN POWERED LIST	
	AVFLAG	5	LM VEHICLE IS ACTIVE	CSM VEHICLE IS ACTIVE
	PFRATFLG	4	PREFERRED ATTITUDE COMPUTED	PREFERRED ATTITUDE NOT COMPUTED
	CALCMAN3	3	NO FINAL ROLL	FINAL ROLL IS NECESSARY
	CALCMAN2	2	PERFORM MANEUVER STARTING PROCEDURE	BYPASS STARTING PROCEDURE
	NODOFLAG	1	V37 NOT PERMITTED	V37 PERMITTED
41B	FLAGWORD 3	BIT	SET	RESET
		15	NOT USED	
	GLOKFAIL	14	GIMBAL LOCK HAS OCCURRED	NOT IN GIMBAL LOCK
	REFSMFLG	13	REFSMMAT GOOD	REFSMMAT NO GOOD
	LUNAFLAG	12	NOT USED IN POWERED LIST	
	P22MKFLG	11	NOT USED IN POWERED LIST	
	VFLAG	10	NOT USED IN POWERED LIST	
	ONMONFLG	9	ON MONITOR ENABLED	ON MONITOR DISABLED
	PRECIFLG	8	NOT USED IN POWERED LIST	
	CULTFLAG	7	NOT USED IN POWERED LIST	

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
41B	FLAGWORD 3	BIT	SET	RESET
	ORBWFLAG	6	NOT USED IN POWERED LIST	
	STATEFLG	5	PERMANENT STATE VECTOR UPDATED	PERMANENT STATE VECTOR NOT UPDATED
	INTYPFLG	4	CONIC INTEGRATION	ENCKE INTEGRATION
	VINTFLAG	3	CSM STATE VECTOR BEING INTEGRATED	LM STATE VECTOR BEING INTEGRATED
	D60R9FLG	2	DIMENSION OF W IS 9 FOR INTEGRATION	DIMENSION OF W IS 6 FOR INTEGRATION
	DIMOFLAG	1	W MATRIX IS TO BE USED	W MATRIX IS NOT TO BE USED
42A	FLAGWORD 4	BIT	SET	RESET
	MRKIDFLG	15	MARK DISPLAY IN ENDIDLE	NO MARK DISPLAY IN ENDIDLE
	PRIODFLG	14	PRIORITY DISPLAY IN ENDIDLE	NO PRIORITY DISPLAY IN ENDIDLE
	NRMIDFLG	13	NORMAL DISPLAY IN ENDIDLE	NO NORMAL DISPLAY IN ENDIDLE
	PDSPFLAG	12	CAN NOT INTERRUPT PRIORITY DISPLAY	
	MWAITFLG	11	HIGHER PRIORITY DISPLAY OPERATING WHEN MARK DISPLAY INITIATED	NO HIGHER PRIORITY DISPLAY OPERATING WHEN MARK DISPLAY INITIATED
	MWAITFLG	10	HIGHER PRIORITY DISPLAY OPERATING WHEN NORMAL DISPLAY INITIATED	NO HIGHER PRIORITY DISPLAY OPERATING WHEN MARK DISPLAY INITIATED
	NWAITFLG	10	HIGHER PRIORITY DISPLAY OPERATING WHEN NORMAL DISPLAY INITIATED	NO HIGHER PRIORITY DISPLAY OPERATING WHEN NORMAL DISPLAY INITIATED
	MRKNVFLG	9	ASTRONAUT USING KEYBOARD WHEN MARK DISPLAY INITIATED	ASTRONAUT NOT USING KEYBOARD WHEN MARK DISPLAY INITIATED
	NRMNVFLG	8	ASTRONAUT USING KEYBOARD WHEN NORMAL DISPLAY INITIATED	ASTRONAUT NOT USING KEYBOARD WHEN NORMAL DISPLAY INITIATED
	PRONVFLG	7	ASTRONAUT USING KEYBOARD WHEN PRIORITY DISPLAY INITIATED	ASTRONAUT NOT USING KEYBOARD WHEN PRIORITY DISPLAY INITIATED
	PINBRFLG	6	ASTRONAUT HAS INTERFERED WITH EXISTING DISPLAY	ASTRONAUT HAS NOT INTERFERED WITH EXISTING DISPLAY
	MRUPTFLG	5	MARK DISPLAY INTERRUPTED BY PRIORITY DISPLAY	MARK DISPLAY NOT INTERRUPTED BY PRIORITY DISPLAY
	NRUPTFLG	4	NORMAL DISPLAY INTERRUPTED BY PRIORITY OR MARK DISPLAY	NORMAL DISPLAY NOT INTERRUPTED BY PRIROITY OR MARK DISPLAY
	MKOVFLAG	3	MARK DISPLAY OVER NORMAL	NO MARK DISPLAY OVER NORMAL
		2	NOT USED	
	XDSPFLAG	1	MARK DISPLAY NOT TO BE INTERRUPTED	

POWERED LIST - Continued

TRANSMITTED IN PROGRAMS 40,41,47,61

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
42B	FLAGWORD 5	BIT	SET	RESET
	DSKYFLAG	15	DISPLAYS SENT TO DSKY	NO DISPLAYS TO DSKY
		14	NOT USED	
		13	NOT USED	
	V59FLAG	12	NOT USED IN POWERED LIST	
	INCORFLG	11	NOT USED IN POWERED LIST	
	PRFTRKAT	10	NOT USED IN POWERED LIST	
	DMENFLG	9	NOT USED IN POWERED LIST	
	COMPUTER	8	COMPUTER IS CMC	COMPUTER IS LGC
	ENGONFLG	7	ENGINE TURNED ON	ENGINE TURNED OFF
	3AXISFLG	6	MANEUVER SPECIFIED BY THREE AXES	MANEUVER SPECIFIED BY ONE AXIS
	GRRBKFLG	5	NOT USED IN POWERED LIST	
	R60FLAG	4	NOT USED IN POWERED LIST	
	SOLNSW	3	NOT USED IN POWERED LIST	
	MGLVFLAG	2	LOCAL VERTICAL COORDINATES COMPUTED	MIDDLE GIMBAL ANGLE COMPUTED
	RENDWFLG	1	NOT USED IN POWERED LIST	
43A	FLAGWORD 6	BIT	SET	RESET
	DAPBIT1, DAPBIT2	15	0 NO DAP, 1 TVC	0 CSM RCS, 1 SATURN
		14	0 OR ENTRY, 1 DAP	0 DAP, 1 DAP
	ENTRYDSP	13	NOT USED IN POWERED LIST	
	CMDAPARM	12	NOT USED IN POWERED LIST	
	GAMDIFSW	11	NOT USED IN POWERED LIST	
	GONEPAST	10	NOT USED IN POWERED LIST	
	RELVELSW	9	NOT USED IN POWERED LIST	
	EGSW	8	NOT USED IN POWERED LIST	
	FIRSTPAS	7	NOT USED IN POWERED LIST	
	HIND	6	NOT USED IN POWERED LIST	
	INRLSW	5	NOT USED IN POWERED LIST	
	LATSW	4	NOT USED IN POWERED LIST	
	.05GSW	3	NOT USED IN POWERED LIST	
	CM/DSTBY	2	NOT USED IN POWERED LIST	
	GYMDIFSW	1	NOT USED IN POWERED LIST	
43B	FLAGWORD 7	BIT	SET	RESET
	TERMIFLG	15	NOT USED IN POWERED LIST	
	ITSWICH	14	NOT USED IN POWERED LIST	
	IGNFLAG	13	TIG HAS ARRIVED	TIG HAS NOT ARRIVED
	ASTNFLAG	12	ASTRONAUT HAS OKAYED IGNITION	ASTRONAUT HAS NOT OKAYED IGNITION
	TIMRFLAG	11	CLOKTAK OPERATING	CLOKTAK INOPERATIVE
	NORMSW	10	UNIT NORMAL COMPUTED	UNIT NORMAL NOT COMPUTED
	RVSW	9	NOT USED IN POWERED LIST	
	GONEBY	8	NOT USED IN POWERED LIST	
	IDLEFLAG	7	NO DV MONITOR	CONNECT DV MONITOR
	V37FLAG	6	AVERAGE G (SERVICER) RUNNING	AVERAGE G (SERVICER) OFF
	NOUPFLAG, R32FLAG	5	NEITHER CSM NOR LM STATE VECTOR MAY BE UPDATED	EITHER STATE VECTOR MAY BE UPDATED
	UPLOCKFL	4	K-$\overline{K}$-K FAIL	NO K-$\overline{K}$-K FAIL
	VERIFLAG	3	NOT USED IN POWERED LIST	
	ATTCHFLG	2	LM, CM ATTACHED	LM, CM NOT ATTACHED
	TFFSW	1	NOT USED IN POWERED LIST	

POWERED LIST - Continued

TRANSMITTED IN PROGRAMS 40,41,37,61

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
44A	FLAGWORD 8	BIT	SET	RESET
	RPQFLAG	15	NOT USED IN POWERED LIST	
		14	NOT USED	
	NEWIFLG	13	NOT USED IN POWERED LIST	
	DMOONFLG	12	NOT USED IN POWERED LIST	
	LMOONFLG	11	NOT USED IN POWERED LIST	
	ADVTRK	10	NOT USED IN POWERED LIST	
	P39/79SW	9	NOT USED IN POWERED LIST	
	SURFFLAG	8	NOT USED IN POWERED LIST	
	INFINFLG	7	NOT USED IN POWERED LIST	
	ORDERSW	6	NOT USED IN POWERED LIST	
	APSESW	5	NOT USED IN POWERED LIST	
	COGAFLAG	4	NOT USED IN POWERED LIST	
		3	NOT USED	
		2	NOT USED	
	360SW	1	NOT USED IN POWERED LIST	
44B	FLAGWORD 9	BIT	SET	RESET
	SWTOVER	15	SWITCHOVER HAS OCCURRED	NO SWITCHOVER YET
		14	NOT USED IN POWERED LIST	
	V67FLAG	13	NOT USED IN POWERED LIST	
	V82EMFLG	12	MAX DB SELECTED	MAX DB NOT SELECTED
	MAXDBFLG	11	NOT USED IN POWERED LIST	
	V94FLAG	10	NOT USED IN POWERED LIST	
	SAVECFLG	9	NOT USED IN POWERED LIST	
	VHFRFLAG	8	NOT USED IN POWERED LIST	
	SOURCFLG	7	NOT USED	
	N22ORN17	6	COMPUTE TOTAL ATTITUDE ERRORS WRT N22 (V62)	COMPUTE TOTAL ATTITUDE ERRORS WRT N17 (V63)
	QUITFLAG	5	CAUSE INTEGRATION TO EXIT AT NEXT TIME STOP	ALLOW INTEGRATION TO CONTINUE
		4	NOT USED IN POWERED LIST	
	R31FLAG	3	INTEGRATE TO TDEC	INTEGRATE TO THE THEN-PRESENT TIME
	MID1FLAG	2	INTEGRATION ENTERED FROM ONE OF MIDTOAV PORTALS	INTEGRATION WAS NOT ENTERED VIA MIDTOAV
	MIDAVFLG	1	AVETOMID CALLING FOR W MATRIX INTEGER DO NOT WRITE OVER RN, VN, PIPTIME	NO AVETOMID W INTEGER ALLOW SET UP OF RN, VN, PIPTIME
	AVEMIDSW			
45A	DSPTAB	DISPLAY TABLE CODES FOR GENERATION OF DSKY NUMERICS		
45B	DSPTAB+1			
46A	DSPTAB+2			
46B	DSPTAB+3			
47A	DSPTAB+4			
47B	DSPTAB+5	USED TO INDICATE VERB-NOUN MAJOR MODE AND R1, R2, AND R3 DISPLAYS		
48A	DSPTAB+6			
48B	DSPTAB+7			
49A	DSPTAB+8			
49B	DSPTAB+9			
50A	DSPTAB+10			
50B	DSPTAB+11	DISPLAY TABLE OF DSKY STATUS LIGHTS 60400_8 = PROGRAM CAUTION, 60200_8 = TRACKER WARNING 60020_8 = NO ATTITUDE, 60040_8 = GIMBAL LOCK		

POWERED LIST - Continued

TRANSMITTED IN PROGRAMS 40,41,47,61

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
51A 51B	TIME2, TIME1	COMPUTER CLOCK INDICATING ELAPSED TIME SINCE LIFTOFF SINCE LIFTOFF
52A 52B	R_X X COMPONENT OF "OTHER" VEHICLE POSITION	"OTHER" VEHICLE STATE VECTOR
53A 53B	R_Y Y COMPONENT OF "OTHER" VEHICLE POSITION	
54A 54B	R_Z Z COMPONENT OF "OTHER" VEHICLE POSITION	
55A 55B	V_X X COMPONENT OF "OTHER" VEHICLE VELOCITY	
56A 56B	V_Y Y COMPONENT OF "OTHER" VEHICLE VELOCITY	
57A 57B	V_Z Z COMPONENT OF "OTHER" VEHICLE VELOCITY	
58A 58B	T_{OTHER} TIME TAG FOR "OTHER" STATE VECTOR	
59A 59B 60A	CDUX CDUY CDUZ	SAME AS 9A SAME AS 9B SAME AS 10A
60B	CDUT	SAME AS 10B
	CSM-RCS DAP / TVC DAP	
61A 61B	$ADOT_X$ / OGARATE	SAME AS 11A, 11B
62A 62B	$ADOT_Y$ / OMEGAYB	SAME AS 12A, 12B
63A 63B	$ADOT_Z$ / OMEGAZB	SAME AS 13A, 13B
64A 64B 65A	AK AK1 AK2	SAME AS 14A SAME AS 14B SAME AS 15A
65B	RCSFLAGS	SAME AS 15B
66A 66B 67A	$THETAD_X$ $THETAD_Y$ $THETAD_Z$	SAME AS 16A SAME AS 16B SAME AS 17A
67B	$DELCDU_X$	SAME AS 17B

POWERED LIST - Continued

TRANSMITTED IN PROGRAMS 40,41,47,61

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
68A 68B	RSBBQ RSBBQ+1	VALUE OF BBANK AND Q REGISTERS AT THE TIME OF A RESTART
69A	CADRFLSH	VALUE OF RETURN ADDRESS INFORMATION FOR LAST REQUESTED PRIORITY DISPLAY
69B	CADRFLSH+1	VALUE OF RETURN ADDRESS INFORMATION FOR LAST REQUESTED MARK
70A	CADRFLSH+2	VALUE OF RETURN ADDRESS INFORMATION FOR LAST NORMAL DISPLAY REQUESTED
70B	FAILREG	CONTAINS ALARM CODE OF FIRST ALARM RECEIVED
71A	FAILREG+1	CONTAINS ALARM CODE OF SECOND ALARM RECEIVED
71B	FAILREG+2	CONTAINS ALARM CODE OF THIRD ALARM RECEIVED
72A	CDUS	SHAFT CDU INPUT COUNTER
72B	PIPAX	X, Y, AND Z PIPA INPUT COUNTERS ZEROED AT THE START OF AVERAGE G AND EVERY 2 SEC DURING AVERAGE G ROUTINE
73A	PIPAY	
73B	PIPAZ	
74A 74B	ELEV	DESIRED LOS ANGLE AT TPI
75A 75B	CENTANG	ORBITAL CENTRAL ANGLE OF THE PASSIVE VEHICLE DURING TRANSFER FROM TPI TO TIME OF INTERCEPT
76A 76B	DELTAR	THE DESIRED SEPARATION OF THE TWO VEHICLES SPECIFIED AS A DISTANCE ALONG THE PASSIVE VEHICLE ORBIT
77A	FLAGWORD 10	
77B	FLAGWORD 11	NOT USED

BIT	SET	RESET
15	NOT USED	
14	INTEGRATION IN PROGRESS	INTEGRATION NOT IN PROGRESS
13	NOT USED	
12	NOT USED	
11	NOT USED	
10	NOT USED	
9	NOT USED	
8	NOT USED	
7	INTEGRATION TO BE RESTARTED	INTEGRATION NOT TO BE RESTARTED
6	NOT USED	
5	NOT USED	
4	NOT USED	
3	NOT USED	
2	NOT USED	
1	NOT USED	

POWERED LIST - Continued

TRANSMITTED IN PROGRAMS 40,41,47,61

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
78A 78B	TEVENT	VALUE OF COMPUTER CLOCK WHEN LIFTOFF OCCURRED, WHEN SPS ENGINE CAME ON OR WHEN SPS ENGINE SHUT OFF
79A 79B	PCMD YCMD	SAME AS 29A SAME AS 29B
80A	OPTMODES	

BIT	SET	RESET
15	NOT ASSIGNED - SHOULD BE ZERO	
14	NOT ASSIGNED - SHOULD BE ZERO	
13	NOT ASSIGNED - SHOULD BE ZERO	
12	NOT ASSIGNED - SHOULD BE ZERO	
11	NOT ASSIGNED - SHOULD BE ZERO	
10	INDICATES OPTICS HAS BEEN ZEROED SINCE LAST FRESH START	ALARM 120_8 WILL BE GENERATED IF ATTEMPT IS MADE TO ZERO OPTICS
9	OPTICS MODE SWITCH IN COMPUTER POSITION	RESET BY FRESH START OR MODE OTHER THAN CMC
8	NOT ASSIGNED - SHOULD BE ZERO	
7	OPTICS CDU FAIL PRESENTLY	NO OPTICS CDU FAIL PRESENTLY
6	NOT ASSIGNED - SHOULD BE ZERO	
5	OPTICS MODE SWITCH NOT IN CMC POSITION	OPTICS MODE SWITCH IN CMC POSITION
4	OPTICS ZERO SWITCH NOT IN ZERO POSITION	OPTICS ZERO SWITCH IN ZERO POSITION
	(BITS 4, 5 = 1'S OPTICS IN MANUAL MODE)	
3	NOT ASSIGNED - SHOULD BE ZERO	
2	NOT ASSIGNED - SHOULD BE ZERO	
1	NOT ASSIGNED - SHOULD BE ZERO	

80B	HOLDFLAG	USED TO DETERMINE NATURE OF ATTITUDE HOLD CONTROL IN CSM RCS DAP. IF >+0 PERFORM ATTITUDE HOLD ABOUT ANGLES CONTAINED IN CDU INPUT COUNTERS (PRESENT IMU ANGLES). IF = +0 PERFORM ATTITUDE HOLD ABOUT EXISTING REFERENCE. IF <+0 AUTOMATIC STEERING IS TO BE PERFORMED.
81A	LEMMASS	MASS OF THE LM
81B	CSMMASS	MASS OF THE CSM
82A	DAPDATR1 LOADED WITH V48N46E	

BITS	
15 14	VEHICLE 0 } NO 0 } LM 1 } LM 1 } SATURN CONFIGURATION 0 } DAP 1 } OFF 0 } ON 1 } DAP
13	NOT USED - SHOULD BE ZERO
12	NOT USED - SHOULD BE ZERO
11	NOT USED - SHOULD BE ZERO
9	NOT USED - SHOULD BE ZERO
8	NOT USED - SHOULD BE ZERO
10 7	X TRANSLATION 0 OR 1 } USE AC 0 } USE 1 } USE USES 0 OR 1 } & BD 1 } AC 0 } BD
6	NOT USED - SHOULD BE ZERO
5	NOT USED - SHOULD BE ZERO

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
82A	DAPDATR1	BITS
		4 — ANGULAR DEADBAND FOR ATTITUDE HOLD AND AUTOMATIC MANEUVERS 0 - ±0.5° DEADBAND 1 - ±5.0° DEADBAND
		3 — NOT USED - SHOULD BE ZERO
		2 — SPECIFY MANEUVER RATE: 0 0 1 1 / 0 1 0 1 — .05°/SEC, .2°/SEC, .5°/SEC, 4.0°/SEC
		1
82B	DAPDATR2	BITS
		15 — NOT USED - SHOULD BE ZERO
		14 — NOT USED - SHOULD BE ZERO
		13 — ROLL JET SELECTION 0 - USE QUAD AC FOR ROLL MANEUVERS 1 - USE QUAD BD FOR ROLL MANEUVERS
		12 — NOT USED - SHOULD BE ZERO
		11 — NOT USED - SHOULD BE ZERO
		10 — A QUAD FAIL 0 - QUAD A IS OK 1 - QUAD A FAILED
		9 — NOT USED - SHOULD BE ZERO
		8 — NOT USED - SHOULD BE ZERO
		7 — B QUAD FAIL 0 - QUAD B IS OK 1 - QUAD B FAILED
		6 — NOT USED - SHOULD BE ZERO
		5 — NOT USED - SHOULD BE ZERO
		4 — C QUAD FAIL 0 - QUAD C IS OK 1 - QUAD C FAILED
		3 — NOT USED - SHOULD BE ZERO
		2 — NOT USED - SHOULD BE ZERO
		1 — D QUAD FAIL 0 - QUAD D IS OK 1 - QUAD D FAILED
83A 83B 84A	$ERROR_X$ $ERROR_Y$ $ERROR_Z$	INTERMEDIATE ATTITUDE ERRORS COMPUTED DURING CSM RCS DAP (DAP FOLLOWING ERRORS). ERRORS IN CONTROL COORDINATES AND ARE LOADED INTO AK'S FOR FDAI DISPLAY WHEN FLAGWORD 0 BIT 9 = 0
84B	$THETAD_X$	SAME AS 16A

	RCS-CSM DAP	TVC DAP	RCS-CSM DAP	TVC DAP
85A 85B	WBODY	OMEGAXC	DESIRED BODY ROLL RATE ABOUT CONTROL AXIS	ROLL BODY AXIS RATE COMMAND FROM CROSS PRODUCT STEERING
86A 86B	WBODY1	OMEGAYC	DESIRED BODY PITCH RATE ABOUT CONTROL AXIS	PITCH BODY AXIS RATE COMMAND FROM CROSS PRODUCT STEERING
87A 87B	WBODY2	OMEGAZC	DESIRED BODY YAW RATE ABOUT CONTROL AXIS	YAW BODY AXIS RATE COMMAND FROM CROSS PRODUCT STEERING

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
88A	REDOCTR	INDICATES THE NUMBER OF RESTARTS WHICH HAVE OCCURRED SINCE LAST FRESH START		
88B	THETAD	FINAL DESIRED X CDU ANGLE		
89A	THETAD+1	FINAL DESIRED Y CDU ANGLE		
89B	THETAD+2	FINAL DESIRED Z CDU ANGLE		
90A	IMODES30	BIT	SET	RESET
		15	IMU TEMPERATURE OUT OF LIMITS	IMU TEMPERATURE WITHIN LIMITS
		14	NO ISS TURN ON REQUEST PRESENT	ISS TURN ON REQUEST PRESENT
		13	NO IMU FAIL	IMU FAIL HAS OCCURRED
		12	NO ICDU FAIL	ICDU FAIL HAS OCCURRED
		11	NO IMU CAGE COMMANDED	IMU CAGE HAS BEEN COMMANDED
		10	NO PIPA FAIL	PIPA FAIL HAS OCCURRED
		9	IMU NOT OPERATING	IMU OPERATING
		8	USED IN IMU TURN-ON SEQUENCING MOST LIKELY ZERO	
		7	SAME AS BIT 8	
		6	IMU INITIALIZATION BEING ACCOMPLISHED	IMU NOT IN INITIALIZATION
		5	INHIBIT ALARM 212$_8$ IF PIPA FAIL OCCURS	DO NOT INHIBIT ALARM 212$_8$ IF PIPA FAIL OCCURS
		4	INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF IMU FAIL OCCURS	DO NOT INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF IMU FAIL OCCURS
		3	INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF ICDU FAIL OCCURS	DO NOT INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF ICDU FAIL OCCURS
		2	TURN-ON DELAY FAILURE (ALARM 207$_8$)	NO TURN-ON DELAY FAILURE
		1	INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF A PIPA FAIL OCCURS	DO NOT INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF A PIPA FAIL OCCURS
90B	IMODES33	BIT	SET	RESET
		15	NOT ASSIGNED - SHOULD BE ZERO	
		14		PROCEED DEPRESSED
		13	PIPA FAIL HAS NOT OCCURRED	PIPA FAIL HAS OCCURRED
		12	TELEMETRY DOWNLINK OK	TELEMETRY DOWNLINK IS TOO FAST
		11	UPLINK IS OK	UPLINK IS TOO FAST
		10	NOT ASSIGNED - SHOULD BE ZERO	
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NOT ASSIGNED - SHOULD BE ZERO	
		6	IMU IN COARSE ALIGN OR ZEROING MODE	IMU NOT IN COARSE ALIGN OR ZEROING MODE
		5	IMU IN ZEROING ROUTINE	IMU NOT IN ZEROING ROUTINE

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WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
90B	IMODES33	BIT	SET	RESET
		4	NOT ASSIGNED - SHOULD BE ZERO	
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	NOT USED	
		1	LAMP TEST IN PROGRESS (V35	LAMP TEST NOT IN PROGRESS
91A	CHANNEL 11	BIT	SET	RESET
		15	NOT ASSIGNED - SHOULD BE ZERO	
		14	NOT ASSIGNED - SHOULD BE ZERO	
		13	SPS ENGINE ON COMMAND	
		12	NOT ASSIGNED - SHOULD BE ZERO	
		11	NOT ASSIGNED - SHOULD BE ZERO	
		10	ERROR RESET KEYCODE RECEIVED FROM UPLINK OR DSKY	
		9	INDICATES AVERAGE G ROUTINE IS RUNNING	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	OPERATOR ERROR HAS OCCURRED	
		6	VERB-NOUN FLASHER ON	
		5	KEY RELEASE LAMP ON	
		4	IMU TEMPERATURE IS OUT OF LIMITS	
		3	UPLINK ACTIVITY LAMP ON	
		2	COMPUTER ACTIVITY LAMP ON	
		1	ISS WARNING LAMP ON	
91B	CHANNEL 12	BIT	SET	RESET
		15	TURN ON DELAY - COMPLETE	
		14	S-IVB CUTOFF COMMAND	
		13	S-IVB INJECTION SEQUENCING START	
		12	NOT ASSIGNED - SHOULD BE ZERO	
		11	DISENGAGE OPTICS DAC	
		10	ZERO OPTICS COMMAND	
		9	S-IVB TAKEOVER ENABLE	
		8	TVC ENABLE	
		7	NOT ASSIGNED - SHOULD BE ZERO	
		6	IMU CDU ERROR COUNTER ENABLE	
		5	IMU CDU ZERO COMMAND	
		4	IMU COARSE ALIGN ENABLE	
		3	STAR TRACKERS ON	
		2	OPTICS CDU ERROR COUNTER ENABLE	
		1	OPTICS CDU ZERO COMMAND	

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
92A	CHANNEL 13	BIT	SET	RESET
		15	T6RUPT ENABLE	
		14	RESET TRAP 32	
		13	RESET TRAP 31-B	
		12	RESET TRAP 31-A	
		11	ENABLE STANDBY BUTTON	
		10	LAMP TEST BEING PERFORMED	
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	BMAG OUTPUT ENABLE	
		7	WORD ORDER CODE FOR WORDS 2-50, 52-100	WORD ORDER CODE FOR WORDS 1 AND 51
		6	BLOCK UPLINK	
		5	INHIBIT UPLINK, ENABLE CROSSLINK	
		4	RANGE UNIT ACTIVITY	
		3	RANGE UNIT SELECT a	
		2	RANGE UNIT SELECT b	
		1	RANGE UNIT SELECT c	
92B	CHANNEL 14	BIT	SET	RESET
		15	XCDU DRIVE ENABLE	
		14	YCDU DRIVE ENABLE	
		13	ZCDU DRIVE ENABLE	
		12	TRUNNION CDU DRIVE ENABLE	
		11	SHAFT CDU DRIVE ENABLE	
		10	GYRO TORQUING ENABLE	
		9	NEGATIVE GYRO TORQUE	POSITIVE GYRO TORQUE
		8	GYRO SELECT 0 0 NO GYRO 1 0 X GYRO 1 1 Y GYRO 1 1 Z GYRO	
		7		
		6	GYRO PULSE TORQUE POWER SUPPLY ENABLED	
		5	NOT USED - SHOULD BE ZERO	
		4	NOT ASSIGNED - SHOULD BE ZERO	
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	NOT ASSIGNED - SHOULD BE ZERO	
		1	NOT USED - SHOULD BE ZERO	
93A	CHANNEL 30	BIT	SET	RESET
		15	IMU TEMPERATURE OUT OF LIMITS	IMU TEMPERATURE WITHIN LIMITS
		14	ISS OFF	ISS ON OR COMMANDED ON
		13	NO IMU FAIL	IMU FAILURE
		12	NO ICDU FAIL	ICDU FAILURE
		11	NO IMU CAGE COMMANDED	IMU CAGE COMMANDED
		10		LAUNCH VEHICLE GUIDANCE SWITCH IN CMC POSITION
		9	IMU NOT OPERATING	IMU OPERATING
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NO OCDU FAIL	OCDU FAILURE
		6	NOT USED	
		5	LIFTOFF HAS NOT OCCURRED	LIFTOFF HAS OCCURRED
		4	S-IVB ATTACHED	S-IVB SEPARATED

POWERED LIST - Continued

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WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
93A	CHANNEL 30	BIT	SET	RESET
		3	SPS NOT READY	SPS READY
		2	CM/SM ATTACHED	CM/SM SEPARATED
		1	ULLAGE THRUST NOT PRESENT FOR S-IVB	ULLAGE THRUST PRESENT FROM S-IVB
93B	CHANNEL 31	BIT	SET	RESET
		15	COMPUTER NOT IN CONTROL OF SPACECRAFT	COMPUTER IN CONTROL OF SPACECRAFT
		14	CSM RCS 0 } ILLEGAL	0 FREE 1 HOLD 1 AUTO
		13	DAP MODE 0 } ILLEGAL	1 MODE 0 MODE 1 MODE
		12		-Z TRANSLATION COMMANDED
		11		+Z TRANSLATION COMMANDED
		10		-Y TRANSLATION COMMANDED
	THC INPUTS	9		+Y TRANSLATION COMMANDED
		8		-X TRANSLATION COMMANDED
		7		+X TRANSLATION COMMANDED
		6		-ROLL COMMANDED
		5		+ROLL COMMANDED
		4		-YAW COMMANDED
	RHC INPUTS	3		+YAW COMMANDED
		2		-PITCH COMMANDED
		1		+PITCH COMMANDED
94A	CHANNEL 32	BIT	SET	RESET
		15	NOT ASSIGNED - SHOULD BE ZERO	
		14		PROCEED KEY IS DEPRESSED
		13	NOT ASSIGNED - SHOULD BE ZERO	
		12	NOT ASSIGNED - SHOULD BE ZERO	
		11		LM ATTACHED
		10	NOT ASSIGNED - SHOULD BE ZERO	
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NOT ASSIGNED - SHOULD BE ZERO	
		6		-ROLL COMMANDED
		5		+ROLL COMMANDED
	MINIMUM IMPULSE CONTROLLER INPUTS	4		-YAW COMMANDED
		3		+YAW COMMANDED
		2		-PITCH COMMANDED
		1		+PITCH COMMANDED
94B	CHANNEL 33	BIT	SET	RESET
		15		COMPUTER OSCILLATOR HAS FAILED
		14		CMC WARNING HAS OCCURRED
		13		PIPA FAIL HAS OCCURRED

TRANSMITTED IN PROGRAMS 40,41,47,61

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
		BIT	SET	RESET
94B	CHANNEL 33	12		TELEMETRY DOWNLINK IS TOO FAST
		11		UPLINK IS TOO FAST
		10	BLOCK UPLINK SWITCH IN NORMAL POSITION	BLOCK UPLINK SWITCH IN BLOCK POSITION
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NOT ASSIGNED - SHOULD BE ZERO	
		6	NOT ASSIGNED - SHOULD BE ZERO	
		5	OPTICS MODE SWITCH IN MANUAL POSITION	OPTICS MODE SWITCH IN COMPUTER POSITION
		4	OPTICS ZERO SWITCH IN NORMAL POSITION	OPTICS ZERO SWITCH IN ZERO POSITION
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	RANGE UNIT DATA NO GOOD	RANGE UNIT DATA GOOD
		1	NOT ASSIGNED - SHOULD BE ZERO	
95A 95B 96A 96B 97A 97B	VGTIGX VGTIGY VGTIGZ	X, Y, AND Z COMPONENTS OF VELOCITY TO BE GAINED		
98A 98B 99A 99B 100A 100B	SPARES			

ORBITAL NAVIGATION

TRANSMITTED IN PROGRAM 22

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
1A	LIST ID	(77773)8 INDICATES PROGRAM 22 POWERED LIST BEING TRANSMITTED.
1B	SYNC BITS	(77340)8 INDICATES DATA TO FOLLOW.
2A 2B	R_X X COMPONENT OF VEHICLE POSITION VECTOR	CSM VEHICLE STATE VECTOR AND TIME
3A 3B	R_Y Y COMPONENT OF VEHICLE POSITION VECTOR	
4A 4B	R_Z Z COMPONENT OF VEHICLE POSITION VECTOR	
5A 5B	V_X X COMPONENT OF VEHICLE VELOCITY VECTOR	
6A 6B	V_Y Y COMPONENT OF VEHICLE VELOCITY VECTOR	
7A 7B	V_Z Z COMPONENT OF VEHICLE VELOCITY VECTOR	
8A 8B	T_{SV} TIME TAG FOR $\overline{R}$ AND $\overline{V}$	
9A 9B 10A	CDUX CDUY CDUZ	X, Y, AND Z CDU INPUT COUNTERS. READ THE IMU COUNTERS ZEROED DURING ZERO ENCODE MODE (IMODES33 BIT 5 = 1)
10B	CDUT	TRUNNION CDU INPUT COUNTER
11A 11B	$ADOT_X$	CMC BODY RATE ABOUT THE X, Y, AND Z AXIS
12A 12B	$ADOT_Y$	
13A 13B	$ADOT_Z$	
14A 14B 15A	AK AK2 AK3	VEHICLE ATTITUDE ERRORS SENT TO FDAI. DURING P11 THE ROLL VALVE IS 4 X 16-2/3 DEG DURING RCS DAP OPERATION EITHER TOTAL ATTITUDE OR DAP FOLLOWING ERROR IS DISPLAYED (DET BY FLAGWORD 0 BIT 9)
15B	RCSFLAGS	

BIT	SET	RESET
15	NOT USED - SHOULD BE ZERO	
14	RATE FILTER NOT INITIALIZED	RATE FILTER INITIALIZED
13	ROLL RATE DAMPING REQUIRED	
12	PITCH RATE DAMPING REQUIRED	
11	YAW RATE DAMPING REQUIRED	
10	-ROLL RHC INPUT	

ORBITAL NAVIGATION - Continued

TRANSMITTED IN PROGRAM 22

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
15B	RCSFLAGS	BIT 9: SET: +ROLL RHC INPUT; RESET:
		BIT 8: SET: -YAW RHC INPUT; RESET:
		BIT 7: SET: +YAW RHC INPUT; RESET:
		BIT 6: SET: -PITCH RHC INPUT; RESET:
		BIT 5: SET: +PITCH RHC INPUT; RESET:
		BIT 4: SET: COMPUTE AK'S (ATTITUDE ERRORS); RESET: PERFORM NEEDLER TO DISPLAY AK'S
		BIT 3: 0 = 3RD PASS THRU; 0 = 2ND PASS THRU; 1 = INITIAL PASS THRU
		BIT 2: 0 = NEEDLER; 1 = NEEDLER; 1 = NEEDLER
		BIT 1: RESET: INITIALIZE T_6 PROGRAM
16A 16B 17A	THETAD$_X$ THETAD$_Y$ THETAD$_Z$	X, Y, AND Z REFERENCE CDU ANGLES FOR THE ATTITUDE HOLD ROUTINE. INTERMEDIATE DESIRED CDU ANGLES FOR AUTO MANEUVER ROUTINE.
17B	DELCDU$_X$	MOST SIGNIFICANT HALF OF X INCREMENTAL GIMBAL ANGLE USED IN AUTOMATIC MANEUVERS
18A	SVMRKDAT	5 SETS OF LANDMARK TRACKING DATA STORED AS FOLLOWS:
18B	SVMRKDAT+1	TIME (DP) - TIME OF MARK
19A	SVMRKDAT+2	CDUY - INNER GIMBAL ANGLE
19B	SVMRKDAT+3	CDUS - OPTICS SHAFT ANGLE
20A	SVMRKDAT+4	CDUZ - MIDDLE GIMBAL ANGLE
20B	SVMRKDAT+5	CDUT - OPTICS TRUNNION ANGLE
21A	SVMRKDAT+6	CDUX - OUTER GIMBAL ANGLE
21B	SVMRKDAT+7	(REPEATED 4 ADDITIONAL TIMES)
22A	SVMRKDAT+8	
22B	SVMRKDAT+9	
23A	SVMRKDAT+10	
23B	SVMRKDAT+11	
24A	SVMRKDAT+12	
24B	SVMRKDAT+13	
25A	SVMRKDAT+14	
25B	SVMRKDAT+15	
26A	SVMRKDAT+16	
26B	SVMRKDAT+17	
27A	SVMRKDAT+18	
27B	SVMRKDAT+19	
28A	SVMRKDAT+20	
28B	SVMRKDAT+21	
29A	SVMRKDAT+22	
29B	SVMRKDAT+23	
30A	SVMRKDAT+24	
30B	SVMRKDAT+25	
31A	SVMRKDAT+26	
31B	SVMRKDAT+27	
32A	SVMRKDAT+28	
32B	SVMRKDAT+29	
33A	SVMRKDAT+30	
33B	SVMRKDAT+31	
34A	SVMRKDAT+32	
34B	SVMRKDAT+33	
35A	SVMRKDAT+34	
35B	SVMRKDAT+35	NOT USED

ORBITAL NAVIGATION - Continued

TRANSMITTED IN PROGRAM 22

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
36A	LANDMARK	BITS		
		15-13	1₈ - LANDMARK KNOWN 2₈ - LANDMARK UNKNOWN	
		12-10	INDEX OF OFFSET DESIGNATOR	
		9-7	NOT USED	
		6-1	00₈ - LANDMARK COORDINATES ARE NOT STORED IN CMC MEMORY 01₈ - LANDING SITE DESIGNATION 02₈ - 26₈ - INDEX NUMBER FOR LANDMARK WHOSE COORDINATES ARE STORED IN CMC MEMORY	
36B	ECC	MOST SIGNIFICANT HALF OF ECCENTRICITY OF CONIC TRAJECTORY		
37A 37B 38A 38B 39A 39B	SPARES			
40A	FLAGWORD 0	BIT	SET	RESET
	CPHIFLAG	15	NOT USED IN ORBITAL NAVIGATION LIST	
	JSWITCH	14	INTEGRATION OF W MATRIX	INTEGRATION OF STATE VECTOR
	MIDFLAG	13	INTEGRATION WITH SOLAR PERTURBATIONS	INTEGRATION WITHOUT SOLAR PERTURBATIONS
	MOONFLAG	12	MOON IS SPHERE OF INFLUENCE	EARTH IS SPHERE OF INFLUENCE
	NORFHOR	11	NOT USED IN ORBITAL NAVIGATION LIST	
	ZMEASURE	10	NOT USED IN ORBITAL NAVIGATION LIST	
	NEEDLFLG	9	TOTAL ATTITUDE ERROR DISPLAYED	A/P FOLLOWING ERROR DISPLAYED
	IMUSE	8	IMU IN USE	IMU NOT IN USE
	RNDVZFLG	7	P20 RUNNING (RADAR IN USE)	P20 NOT RUNNING (RADAR NOT IN USE)
	R53FLAG	6	V51 INITIATED	V51 NOT INITIATED
	F2RTE	5	NOT USED IN ORBITAL NAVIGATION LIST	
	TRUNFLAG	4	DRIVING OF TRUNNION ALLOWED	DRIVING OF TRUNNION NOT ALLOWED
	FREEFLAG	3	NOT USED IN ORBITAL NAVIGATION LIST	
	B29FLAG	2	NOT USED	
	KFLAG	1	NOT USED IN ORBITAL NAVIGATION LIST	
40B	FLAGWORD 1	BIT	SET	RESET
	NJETSFLG	15	NOT USED IN ORBITAL NAVIGATION LIST	
	STIKFLAG	14	RHC CONTROL OF RCS	CMC CONTROL OF RCS
	ERADFLAG	13	COMPUTE REARTH FISCHER ELLIPSOID	USE CONSTANT REARTH PAD RADIUS
		12	NOT USED	
	ENG2FLAG	11	NOT USED IN ORBITAL NAVIGATION LIST	
	TARG1FLG	10	SIGHTING LM	NOT SIGHTING LM
	TARG2FLG	9	SIGHTING LANDMARK	SIGHTING STAR

TRANSMITTED IN PROGRAM 22

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
40B	FLAGWORD 1	BIT	SET	RESET
	R23FLG	9	NOT USED IN ORBITAL NAVIGATION LIST	
	VEHUPFLG	8	CSM STATE VECTOR BEING UPDATED	LM STATE VECTOR BEING UPDATED
	UPDATFLG	7	NOT USED IN ORBITAL NAVIGATION LIST	
	IDLEFAIL	6	NOT USED IN ORBITAL NAVIGATION LIST	
	TRACKFLG	5	TRACKING ALLOWED	TRACKING NOT ALLOWED
		4	NOT USED	
	SLOPESW	3	NOT USED IN ORBITAL NAVIGATION LIST	
	GUESSW	2	NOT USED IN ORBITAL NAVIGATION LIST	
	AVEGFLAG	1	AVERAGE G (SERVICER) TO CONTINUE	AVERAGE G (SERVICER) TO CEASE
41A	FLAGWORD 2	BIT	SET	RESET
	DRIFTFLG	15	T3RUPT CALLS GYRO COMPENSATION	T3RUPT DOES NO GYRO COMPENSATION
	R21MARK	14	NOT USED IN ORBITAL NAVIGATION LIST	
	22DSPFLG	13	DISPLAY DR, DV	DO NOT DISPLAY DR, DV
		12	NOT USED	
	STERRSW	11	NOT USED IN ORBITAL NAVIGATION LIST	
	CYCLESW	10	NOT USED IN ORBITAL NAVIGATION LIST	
	IMPULSW	9	NOT USED IN ORBITAL NAVIGATION LIST	
	XDELVFLG	8	NOT USED IN ORBITAL NAVIGATION LIST	
	ETPIFLAG, OPTNSW	7	NOT USED IN ORBITAL NAVIGATION LIST	
	FINALFLG	6	NOT USED IN ORBITAL NAVIGATION LIST	
	AVFLAG	5	NOT USED IN ORBITAL NAVIGATION LIST	
	PFRATFLG	4	PREFERRED ATTITUDE COMPUTED	PREFERRED ATTITUDE NOT COMPUTED
	CALCMAN3	3	NOT USED IN ORBITAL NAVIGATION LIST	
	CALCMAN2	2	NOT USED IN ORBITAL NAVIGATION LIST	
	NODOFLAG	1	V37 NOT PERMITTED	V37 PERMITTED
41B	FLAGWORD 3	BIT	SET	RESET
		15	NOT USED	
	GLOKFAIL	14	GIMBAL LOCK HAS OCCURRED	NOT IN GIMBAL LOCK
	REFSMFLG	13	REFSMMAT GOOD	REFSMMAT NO GOOD
	LUNAFLAG	12	LUNAR LAT-LONG	EARTH LAT-LONG
	P22MKFLG	11	P22 DOWNLINKED MARK DATA WAS JUST TAKEN	P22 DOWNLINKED MARK DATA NOT JUST TAKEN
	VFLAG	10	NOT USED IN ORBITAL NAVIGATION LIST	
	ONMONFLG	9	NOT USED IN ORBITAL NAVIGATION LIST	
	PRECIFLG	8	CSMPREC OR LEMPREC CALLED	INTEGRV OR INTEGRVS CALLED
	CULTFLAG	7	STAR OCCULTED	STAR NOT OCCULTED
	ORBWFLAG	6	W MATRIX VALID FOR ORBITAL INTEGRATION	W MATRIX INVALID FOR ORBITAL INTEGRATION
	STATEFLG	5	PERMANENT STATE VECTOR UPDATED	PERMANENT STATE VECTOR NOT UPDATED
	INTYPFLG	4	CONIC INTEGRATION	ENCKE INTEGRATION
	VINTFLAG	3	CSM STATE VECTOR BEING INTEGRATED	LM STATE VECTOR BEING INTEGRATED
	D60R9FLG	2	DIMENSION OF W IS 9 FOR INTEGRATION	DIMENSION OF W IS 6 FOR INTEGRATION
	DIMOFLAG	1	W MATRIX IS TO BE USED	W MATRIX IS NOT TO BE USED

TRANSMITTED IN PROGRAM 22

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
42A	FLAGWORD 4	BIT	SET	RESET
	MRKIDFLG	15	MARK DISPLAY IN ENDIDLE	NO MARK DISPLAY IN ENDIDLE
	PRIODFLG	14	PRIORITY DISPLAY IN ENDIDLE	NO PRIORITY DISPLAY IN ENDIDLE
	NRMIDFLG	13	NORMAL DISPLAY IN ENDIDLE	NO NORMAL DISPLAY IN ENDIDLE
	PDSPFLAG	12	CAN NOT INTERRUPT PRIORITY DISPLAY	
	MWAITFLG	11	HIGHER PRIORITY DISPLAY OPERATING WHEN MARK DISPLAY INITIATED	NO HIGHER PRIORITY DISPLAY OPERATING WHEN MARK DISPLAY INITIATED
	NWAITFLG	10	HIGHER PRIORITY DISPLAY OPERATING WHEN NORMAL DISPLAY INITIATED	NO HIGHER PRIORITY DISPLAY OPERATING WHEN NORMAL DISPLAY INITIATED
	MRKNVFLG	9	ASTRONAUT USING KEYBOARD WHEN MARK DISPLAY INITIATED	ASTRONAUT NOT USING KEYBOARD WHEN MARK DISPLAY INITIATED
	NRMNVFLG	8	ASTRONAUT USING KEYBOARD WHEN NORMAL DISPLAY INITIATED	ASTRONAUT NOT USING KEYBOARD WHEN NORMAL DISPLAY INITIATED
	PRONVFLG	7	ASTRONAUT USING KEYBOARD WHEN PRIORITY DISPLAY INITIATED	ASTRONAUT NOT USING KEYBOARD WHEN PRIORITY DISPLAY INITIATED
	PINBRFLG	6	ASTRONAUT HAS INTERFERED WITH EXISTING DISPLAY	ASTRONAUT HAS NOT INTERFERED WITH EXISTING DISPLAY
	MRUPTFLG	5	MARK DISPLAY INTERRUPTED BY PRIORITY DISPLAY	MARK DISPLAY NOT INTERRUPTED BY PRIORITY DISPLAY
	NRUPTFLG	4	NORMAL DISPLAY INTERRUPTED BY PRIORITY OR MARK DISPLAY	NORMAL DISPLAY NOT INTERRUPTED BY PRIORITY OR MARK DISPLAY
	MKOVFLAG	3	MARK DISPLAY OVER NORMAL	NO MARK DISPLAY OVER NORMAL
		2	NOT USED - SHOULD BE ZERO	
	XDSPFLAG	1	MARK DISPLAY NOT TO BE INTERRUPTED	
42B	FLAGWORD 5	BIT	SET	RESET
	DSKYFLAG	15	DISPLAYS SENT TO DSKY	NO DISPLAYS TO DSKY
		14	NOT USED	
		13	NOT USED	
	V59FLAG	12	NOT USED IN ORBITAL NAVIGATION LIST	
	INCORFLG	11	FIRST INCORPORATION	SECOND INCORPORATION
	PRFTRKAT	10	PREFERRED TRACKING ATTITUDE	+X AXIS TRACKING ATTITUDE
	DMENFLG	9	DIMENSION OF W IS 9 FOR INCORPORATION	DIMENSION OF W IS 6 FOR INCORPORATION
	COMPUTER	8	COMPUTER IS CMC	COMPUTER IS LGC
	ENGONFLG	7	NOT USED IN ORBITAL NAVIGATION LIST	
	3AXISFLG	6	NOT USED IN ORBITAL NAVIGATION LIST	
	GRRBKFLG	5	NOT USED IN ORBITAL NAVIGATION LIST	
	R60FLAG	4	R61 MUST USE R60	NORMAL R61

ORBITAL NAVIGATION - Continued

TRANSMITTED IN PROGRAM 22

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
42B	FLAGWORD 5	BIT	SET	RESET
	SOLNSW	3	NOT USED IN ORBITAL NAVIGATION LIST	
	MGLVFLAG	2	NOT USED IN ORBITAL NAVIGATION LIST	
	RENDWFLG	1	W MATRIX VALID FOR RENDEZVOUS NAVIGATION	W MATRIX INVALID FOR RENDEZVOUS NAVIGATION
43A	FLAGWORD 6	BIT	SET	RESET
	DAPBIT1	15	0 } NO DAP OR 0 } ENTRY	0 } CSM RCS 1 } DAP
		14		1 } TVC DAP 0 } SATURN DAP 1 }
	ENTRYDSP	13	NOT USED IN ORBITAL NAVIGATION LIST	
	CMDAPARM	12	NOT USED IN ORBITAL NAVIGATION LIST	
	GAMDIFSW	11	NOT USED IN ORBITAL NAVIGATION LIST	
	GONEPAST	10	NOT USED IN ORBITAL NAVIGATION LIST	
	RELVELSW	9	NOT USED IN ORBITAL NAVIGATION LIST	
	KNOWNFLG	8	LANDMARK KNOWN	LANDMARK UNKNOWN
	FIRSTPAS	7	NOT USED IN ORBITAL NAVIGATION LIST	
	HIND	6	NOT USED IN ORBITAL NAVIGATION LIST	
	INRLSW	5	NOT USED IN ORBITAL NAVIGATION LIST	
	LATSW	4	NOT USED IN ORBITAL NAVIGATION LIST	
	.05GSW	3	NOT USED IN ORBITAL NAVIGATION LIST	
	CM/DSTBY	2	NOT USED IN ORBITAL NAVIGATION LIST	
	GYMDIFSW	1	NOT USED IN ORBITAL NAVIGATION LIST	
43B	FLAGWORD 7	BIT	SET	RESET
	TERMIFLG	15	TERMINATE R21, R22	
	ITSWICH	14	NOT USED IN ORBITAL NAVIGATION LIST	
	IGNFLAG	13	NOT USED IN ORBITAL NAVIGATION LIST	
	ASTNFLAG	12	NOT USED IN ORBITAL NAVIGATION LIST	
	TIMRFLAG	11	NOT USED IN ORBITAL NAVIGATION LIST	
	NORMSW	10	NOT USED IN ORBITAL NAVIGATION LIST	
	RVSW	9	NOT USED IN ORBITAL NAVIGATION LIST	
	GONEBY	8	NOT USED IN ORBITAL NAVIGATION LIST	
	IDLEFLAG	7	NO DV MONITOR	CONNECT DV MONITOR
	V37FLAG	6	AVERAGE G (SERVICER RUNNING	AVERAGE G (SERVICER OFF
	NOUPFLAG	5	NOT USED IN ORBITAL NAVIGATION LIST	
	UPLOCKFL	4	K-KBAR-K FAIL	NO K-KBAR-K FAIL
	VERIFLAG	3	NOT USED IN ORBITAL NAVIGATION LIST	
	ATTCHFLG	2	NOT USED IN ORBITAL NAVIGATION LIST	
	TFFSW	1	NOT USED IN ORBITAL NAVIGATION LIST	
44A	FLAGWORD 8	BIT	SET	RESET
	RPQFLAG	15	RPQ NOT COMPUTED	RPQ COMPUTED
		14	NOT USED	
	NEWIFLG	13	FIRST PASS THROUGH INTEGRATION	SUCCEEDING INTEGRATION OF INTEGRATION
	CMOONFLG	12	PERMANENT CSM STATE IN LUNAR SPHERE	PERMANENT CSM STATE IN EARTH SPHERE
	LMOONFLG	11	PERMANENT LM STATE IN LUNAR SPHERE	PERMANENT LM STATE IN EARTH SPHERE
	ADVTRK	10	ADVANCE GROUND TRACK SIGHTING WANTED	NOT ADVANCED GROUND TRACK
	P39/79 SW	9	NOT USED IN ORBITAL NAVIGATION LIST	
	SURFFLAG	8	LM ON LUNAR SURFACE	LM NOT ON LUNAR SURFACE

ORBITAL NAVIGATION - Continued

TRANSMITTED IN PROGRAM 22

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
44A	FLAGWORD 8	BIT	SET	RESET
	INFINFLG	7	NOT USED IN ORBITAL NAVIGATION LIST	
	ORDERSW	6	NOT USED IN ORBITAL NAVIGATION LIST	
	APSESW	5	NOT USED IN ORBITAL NAVIGATION LIST	
	COGAFLAG	4	NOT USED IN ORBITAL NAVIGATION LIST	
		3	NOT USED	
		2	NOT USED	
	360SW	1	NOT USED IN ORBITAL NAVIGATION LIST	
44B	FLAGWORD 9	BIT	SET	RESET
	SWTOVER	15	NOT USED IN ORBITAL NAVIGATION LIST	
	V67FLAG	14	NOT USED IN ORBITAL NAVIGATION LIST	
	V82EMFLG	13	MOON VICINITY	EARTH VICINITY
	MAXDBFLG	12	MAX DB SELECTED	MAX DB NOT SELECTED
	V94FLAG	11	NOT USED IN ORBITAL NAVIGATION LIST	
	SAVECFLG	10	NOT USED IN ORBITAL NAVIGATION LIST	
	VHFRFLAG	9	NOT USED IN ORBITAL NAVIGATION LIST	
	SOURCFLG	8	NOT USED IN ORBITAL NAVIGATION LIST	
	R22CAFLG	7	NOT USED	
	N22ORN17	6	COMPUTE TOTAL ATTITUDE ERRORS WRT N22 (V62)	COMPUTE TOTAL ATTITUDE ERRORS WRT N17 (V63)
	QUITFLAG	5	CAUSE INTEGRATION TO EXIT AT NEXT TIME STEP	ALLOW INTEGRATION TO CONTINUE
	R31FLAG	4	NOT USED IN ORBITAL NAVIGATION LIST	
	MID1FLAG	3	INTEGRATE TO TDEC	INTEGRATE TO THE THEN-PRESENT TIME
	MIDAVFLG	2	INTEGRATION ENTERED FROM ONE OF MIDTOAV PORTALS	INTEGRATION WAS NOT ENTERED VIA MIDTOAV
	AVEMIDSW	1	AVETOMID CALLING FOR W MATRIX INTEGER DO NOT WRITE OVER RN, VN, PIPTIME	NO AVETOMID W INTEGER ALLOW SET UP OF RN, VN, PIPTIME
45A	DSPTAB	DISPLAY TABLE CODES FOR GENERATION OF DSKY NUMERICS		
45B	DSPTAB+1			
46A	DSPTAB+2			
46B	DSPTAB+3			
47A	DSPTAB+4			
47B	DSPTAB+5	USED TO INDICATE VERB-NOUN MAJOR MODE AND R_1, R_2, AND R_3 DISPLAYS		
48A	DSPTAB+6			
48B	DSPTAB+7			
49A	DSPTAB+8			
49B	DSPTAB+9			
50A	DSPTAB+10			
50B	DSPTAB +11	DISPLAY TABLE TO DSKY STATUS LIGHTS 60400_8 = PROGRAM CAUTION, 60200_8 = TRACKER WARNING 60020_8 = NO ATTITUDE, 60040_8 = GIMBAL LOCK		

ORBITAL NAVIGATION - Continued

TRANSMITTED IN PROGRAM 22

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
51A 51B	TIME2, TIME1	COMPUTER CLOCK INDICATING ELAPSED TIME SINCE LIFTOFF
52A 52B	LAT	LATITUDE OF LANDMARK
53A 53B	LONG	LONGITUDE OF LANDMARK
54A 54B	ALT	ALTITUDE OF LANDMARK
55A 55B 56A 56B 57A 57B 58A 58B	SPARES	
59A 59B 60A	CDUX CDUY CDUZ	SAME AS 9A SAME AS 9B SAME AS 10A
60B	CDUT	SAME AS 10B
61A 61B	$ADOT_X$	SAME AS 11A, 11B
62A 62B	$ADOT_Y$	SAME AS 12A, 12B
63A 63B	$ADOT_Z$	SAME AS 13A, 13B
64A 64B 65A	AK AK1 AK2	SAME AS 14A SAME AS 14B SAME AS 15A
65B	RCSFLAGS	SAME AS 15B
66A 66B 67A	$THETAD_X$ $THETAD_Y$ $THETAD_Z$	SAME AS 16A SAME AS 16B SAME AS 17A
67B	$DELCDU_X$	SAME AS 17B
68A 68B	RSBBQ, +1	VALUE OF BBANK AND Q REGISTERS AT THE TIME OF A RESTART

TRANSMITTED IN PROGRAM 22

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
69A	CADRFLSH	VALUE OF RETURN ADDRESS INFORMATION FOR LAST REQUESTED PRIORITY DISPLAY
69B	CADRFLSH+1	VALUE OF RETURN ADDRESS INFORMATION LAST REQUESTED MARK
70A	CADRFLSH+2	VALUE OF RETURN ADDRESS INFORMATION FOR LAST NORMAL DISPLAY REQUESTED
70B 71A 71B	FAILREG FAILREG+1 FAILREG+2	CONTAINS ALARM CODE OF FIRST ALARM RECEIVED CONTAINS ALARM CODE OF SECOND ALARM RECEIVED CONTAINS ALARM CODE OF THIRD ALARM RECEIVED
72A	CDUS	SHAFT CDU INPUT COUNTER
72B 73A 73B	PIPAX PIPAY PIPAZ	X, Y, AND Z INPUT COUNTERS ZEROED AT THE START OF AVERAGE G AND ENTRY ROUTINES READ EVERY 2 SEC DURING AVERAGE G ROUTINE
74A	8NN	NUMBER OF MARKS
74B	S22LOC	ADDRESS OF MARK DATA REGISTER
75A	FLAGWORD 10	

BIT	SET	RESET
15	NOT USED	
14 (INTFLBIT)	INTEGRATION IN PROGRESS	INTEGRATION IN PROGRESS
13	NOT USED	
12	NOT USED	
11	NOT USED	
10	NOT USED	
9	NOT USED	
8	NOT USED	
7 (REINTFLG, REINTBIT)	INTEGRATION ROUTINE TO BE RESTARTED	INTEGRATION ROUTINE NOT TO BE RESTARTED
6	NOT USED	
5	NOT USED	
4	NOT USED	
3	NOT USED	
2	NOT USED	
1	NOT USED	

75B	FLAGWORD 11	NOT USED
76A 76B	RLS_X	X, Y, AND Z OF LUNAR LANDING SITE VECTOR
77A 77B	RLS_Y	
78A 78B	RLS_Z	
79A 79B	SPARES	

ORBITAL NAVIGATION - Continued

TRANSMITTED IN PROGRAM 22

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
80A	OPTMODES	BIT / SET / RESET
		15 — NOT ASSIGNED - SHOULD BE ZERO
		14 — NOT ASSIGNED - SHOULD BE ZERO
		13 — NOT ASSIGNED - SHOULD BE ZERO
		12 — NOT ASSIGNED - SHOULD BE ZERO
		11 — NOT ASSIGNED - SHOULD BE ZERO
		10 — SET: INDICATES OPTICS HAS BEEN ZEROED SINCE LAST FRESH START; RESET: ALARM 120_8 WILL BE GENERATED IF ATTEMPT IS MADE TO ZERO OPTICS
		9 — SET: OPTICS MODE SWITCH IN COMPUTER POSITION; RESET: RESET BY FRESH START OR MODE OTHER THAN CMC
		8 — NOT ASSIGNED - SHOULD BE ZERO
		7 — SET: OPTICS CDU FAIL PRESENTLY; RESET: NO OPTICS CDU FAIL PRESENTLY
		6 — NOT ASSIGNED - SHOULD BE ZERO
		5 — SET: OPTICS MODE SWITCH NOT IN CMC POSITION; RESET: OPTICS MODE SWITCH IN CMC POSITION
		4 — SET: OPTICS ZERO SWITCH NOT IN ZERO POSITION; RESET: OPTICS ZERO SWITCH IN ZERO POSITION
		(BIT 4 AND 5 = 1'S OPTICS IN MANUAL MODE)
		3 — NOT ASSIGNED - SHOULD BE ZERO
		2 — NOT ASSIGNED - SHOULD BE ZERO
		1 — NOT ASSIGNED - SHOULD BE ZERO
80B	HOLDFLAG	USED TO DETERMINE NATURE OF ATTITUDE HOLD CONTROL IN CMS RCS DAP. IF >+0 PERFORM ATTITUDE HOLD ABOUT ANGLES CONTAINED IN CDU INPUT COUNTERS (PRESENT IMU ANGLES). IF = +0 PERFORM ATTITUDE HOLD ABOUT EXISTING REFERENCE. IF <+0 AUTOMATIC STEERING IS TO BE PERFORMED.
81A	LEMMASS	MASS OF THE LM
81B	CSMMASS	MASS OF THE CSM
82A	DAPDATR1	BITS
	LOADED WITH V48N46E	15 — NOT USED - SHOULD BE ZERO
		14, 13 — VEHICLE CONFIGURATION: 0,0 = NO DAP; 0,1 = CM ONLY; 1,0 = CSM AND LM; 1,1 = SATURN DAP
		12 — NOT USED - SHOULD BE ZERO
		11 — NOT USED - SHOULD BE ZERO
		10, 7 — X TRANSLATION USES: 0,1 OR 0,1 = USE AC AND BD; 1,0 = USE AC; 1,1 = USE BD
		9 — NOT USED - SHOULD BE ZERO
		8 — NOT USED - SHOULD BE ZERO
		6 — NOT USED - SHOULD BE ZERO
		5 — NOT USED - SHOULD BE ZERO
		4 — ANGULAR DEADBAND FOR ATTITUDE HOLD AND AUTOMATIC MANEUVERS 0 - ±0.5° DEADBAND 1 - ±5.0° DEADBAND
		3 — NOT USED - SHOULD BE ZERO
		2, 1 — SPECIFY MANEUVER RATE: 0,0 = .05°/SEC; 0,1 = .2°/SEC; 1,0 = .5°/SEC; 1,1 = 4.0°/SEC

ORBITAL NAVIGATION - Continued

TRANSMITTED IN PROGRAM 22

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE	
82B	DAPDATR2	BITS	
		15	NOT USED - SHOULD BE ZERO
		14	NOT USED - SHOULD BE ZERO
		13	ROLL JET SELECTION 0 - USE QUAD AC FOR ROLL MANEUVERS 1 - USE QUAD BD FOR ROLL MANEUVERS
		12	NOT USED - SHOULD BE ZERO
		11	NOT USED - SHOULD BE ZERO
		10	A QUAD FAIL 0 - QUAD A IS OK 1 - QUAD A FAILED
		9	NOT USED - SHOULD BE ZERO
		8	NOT USED - SHOULD BE ZERO
		7	B QUAD FAIL 0 - QUAD B IS OK 1 - QUAD B FAILED
		6	NOT USED - SHOULD BE ZERO
		5	NOT USED - SHOULD BE ZERO
		4	C QUAD FAIL 0 - QUAD C IS OK 1 - QUAD C FAILED
		3	NOT USED - SHOULD BE ZERO
		2	NOT USED - SHOULD BE ZERO
		1	D QUAD FAIL 0 - QUAD D IS OK 1 - QUAD D FAILED
83A 83B 84A	$ERROR_X$ $ERROR_Y$ $ERROR_Z$	INTERMEDIATE ATTITUDE ERRORS COMPUTED DURING CSM RCS DAP (DAP FOLLOWING ERRORS). ERRORS IN CONTROL COORDINATES AND ARE LOADED INTO AK'S FOR FDAI DISPLAY WHEN FWD0 BIT 9=0.	
84B	$THETAD_X$	SAME AS 16A	
85A 85B	WBODY	DESIRED BODY ROLL RATE ABOUT CONTROL AXIS	
86A 86B	WBODY1	DESIRED BODY PITCH RATE ABOUT CONTROL AXIS	
87A 87B	WBODY2	DESIRED BODY YAW RATE ABOUT CONTROL AXIS	
88A	REDOCTR	INDICATES THE NUMBER OF RESTARTS WHICH HAVE OCCURRED SINCE LAST FRESH START	
88B 89A 89B	THETAD THETAD+1 THETAD+2	FINAL DESIRED X CDU ANGLE FINAL DESIRED Y CDU ANGLE FINAL DESIRED Z CDU ANGLE	

TRANSMITTED IN PROGRAM 22

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
90A	IMODES30	BIT	SET	RESET
		15	IMU TEMPERATURE OUT OF LIMITS	IMU TEMPERATURE WITHIN LIMITS
		14	NO ISS TURN ON REQUEST PRESENT	ISS TURN ON REQUEST PRESENT
		13	NO IMU FAIL	IMU FAIL HAS OCCURRED
		12	NO ICDU FAIL	ICDU FAIL HAS OCCURRED
		11	NO IMU CAGE COMMANDED	IMU CAGE HAS BEEN COMMANDED
		10	NO PIPA FAIL	PIPA FAIL HAS OCCURRED
		9	IMU NOT OPERATING	IMU OPERATING
		8	USED IN IMU TURN-ON SEQUENCING MOST LIKELY ZERO	
		7	SAME AS BIT 8	
		6	IMU INITIALIZATION BEING ACCOMPLISHED	IMU NOT IN INITIALIZATION
		5	INHIBIT ALARM 212_8 IF PIPA FAIL OCCURS	DO NOT INHIBIT ALARM 212_8 IF PIPA FAIL OCCURS
		4	INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF IMU FAIL OCCURS	DO NOT INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF IMU FAIL OCCURS
		3	INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF ICDU FAIL OCCURS	DO NOT INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF ICDU FAIL OCCURS
		2	TURN-ON DELAY FAILURE (ALARM 207_8)	NO TURN-ON DELAY FAILURE
		1	INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF A PIPA FAIL OCCURS	DO NOT INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF A PIPA FAIL OCCURS
90B	IMODES33	BIT	SET	RESET
		15	NOT ASSIGNED - SHOULD BE ZERO	
		14		
		13	PIPA FAIL HAS NOT OCCURRED	PIPA FAIL HAS OCCURRED
		12	TELEMETRY DOWNLINK OK	TELEMETRY DOWNLINK IS TOO FAST
		11	UPLINK IS OK	UPLINK IS TOO FAST
		10	NOT ASSIGNED - SHOULD BE ZERO	
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NOT ASSIGNED - SHOULD BE ZERO	
		6	IMU IN COARSE ALIGN OR ZEROING MODE	IMU NOT IN COARSE ALIGN OR ZEROING MODE
		5	IMU IN ZEROING ROUTINE	IMU NOT IN ZEROING ROUTINE
		4	NOT ASSIGNED - SHOULD BE ZERO	
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	NOT USED	
		1	LAMP TEST IN PROGRESS (V35)	LAMP TEST NOT IN PROGRESS

ORBITAL NAVIGATION - Continued

TRANSMITTED IN PROGRAM 22

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
91A	CHANNEL 11	BIT	SET	RESET
		15	NOT ASSIGNED - SHOULD BE ZERO	
		14	NOT ASSIGNED - SHOULD BE ZERO	
		13	SPS ENGINE ON COMMAND	
		12	NOT ASSIGNED - SHOULD BE ZERO	
		11	NOT ASSIGNED - SHOULD BE ZERO	
		10	ERROR RESET KEYCODE RECEIVED FROM UPLINK OR DSKY	
		9	INDICATES AVERAGE G ROUTINE IS RUNNING	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	OPERATOR ERROR HAS OCCURRED	
		6	VERB-NOUN FLASHER ON	
		5	KEY RELEASE LAMP ON	
		4	IMU TEMPERATURE IS OUT OF LIMITS	
		3	UPLINK ACTIVITY LAMP ON	
		2	COMPUTER ACTIVITY LAMP ON	
		1	ISS WARNING LAMP ON	
91B	CHANNEL 12	BIT	SET	RESET
		15	TURN-ON DELAY - COMPLETE	
		14	S-IVB CUTOFF COMMAND	
		13	S-IVB INJECTION SEQUENCING START	
		12	NOT ASSIGNED - SHOULD BE ZERO	
		11	DISENGAGE OPTICS DAC	
		10	ZERO OPTICS COMMAND	
		9	S-IVB TAKEOVER ENABLE	
		8	TVC ENABLE	
		7	NOT ASSIGNED - SHOULD BE ZERO	
		6	IMU CDU ERROR COUNTER ENABLE	
		5	IMU CDU ZERO COMMAND	
		4	IMU COARSE ALIGN ENABLE	
		3	STAR TRACKERS ON	
		2	OPTICS CDU ERROR COUNTER ENABLE	
		1	OPTICS CDU ZERO COMMAND	
92A	CHANNEL 13	BIT	SET	RESET
		15	T6RUPT ENABLE	
		14	RESET TRAP 32	
		13	RESET TRAP 31-B	
		12	RESET TRAP 31-A	
		11	ENABLE STANDBY BUTTON	
		10	LAMP TEST BEING PERFORMED	
		9	NOT ASSIGNED - SHOULD BE ZERO	

ORBITAL NAVIGATION - Continued

TRANSMITTED IN PROGRAM 22

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
92A	CHANNEL 13	BIT	SET	RESET
		8	BMAG OUTPUT ENABLE	
		7	WORD ORDER CODE FOR WORDS 2-50, 52-100	WORD ORDER CODE FOR WORDS 1 AND 51
		6	BLOCK UPLINK	
		5	INHIBIT UPLINK, ENABLE CROSSLINK	
		4	RANGE UNIT ACTIVITY	
		3	RANGE UNIT SELECT a	
		2	RANGE UNIT SELECT b	
		1	RANGE UNIT SELECT c	
92B	CHANNEL 14	BIT	SET	RESET
		15	XCDU DRIVE ENABLE	
		14	YCDU DRIVE ENABLE	
		13	ZCDU DRIVE ENABLE	
		12	TRUNNION CDU DRIVE ENABLE	
		11	SHAFT CDU DRIVE ENABLE	
		10	GYRO TORQUING ENABLE	
		9	NEGATIVE GYRO TORQUE	POSITIVE GYRO TORQUE
		8	GYRO SELECT 0: NO GYRO 0 / GYRO 1	X GYRO 1: 0 / 1
		7		Y GYRO 1: 0 / 1
				Z GYRO 1: 0 / 1
		6	GYRO PULSE TORQUE POWER SUPPLY ENABLED	
		5	NOT USED - SHOULD BE ZERO	
		4	NOT ASSIGNED - SHOULD BE ZERO	
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	NOT ASSIGNED - SHOULD BE ZERO	
		1	NOT USED - SHOULD BE ZERO	
93A	CHANNEL 30	BIT	SET	RESET
		15	IMU TEMPERATURE OUT OF LIMITS	IMU TEMPERATURE WITHIN LIMITS
		14	ISS OFF	ISS ON OR COMMANDED ON
		13	NO IMU FAIL	IMU FAILURE
		12	NO ICDU FAIL	ICDU FAILURE
		11	NO IMU CAGE COMMANDED	IMU CAGE COMMANDED
		10		LAUNCH VEHICLE GUIDANCE SWITCH IN CMC POSITION
		9	IMU NOT OPERATING	IMU OPERATING
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NO OCDU FAIL	OCDU FAILURE
		6	NOT USED	
		5	LIFTOFF HAS NOT OCCURRED	LIFTOFF HAS OCCURRED
		4	S-IVB ATTACHED	S-IVB SEPARATED
		3	SPS NOT READY	SPS READY
		2	CM/SM ATTACHED	CM/SM SEPARATED
		1	ULLAGE THRUST NOT PRESENT FOR S-IVB	ULLAGE THRUST PRESENT FROM S-IVB

TRANSMITTED IN PROGRAM 22

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
93B	CHANNEL 31	BIT	SET	RESET
		15	COMPUTER NOT IN CONTROL OF SPACECRAFT	COMPUTER IN CONTROL OF SPACECRAFT
		14	CSM RCS DAP MODE 0 = ILLEGAL	1 = FREE MODE, 1 = HOLD MODE, 1 = AUTO MODE
		13	CSM RCS DAP MODE 1 = ILLEGAL	0 = FREE MODE, 0 = HOLD MODE, 1 = AUTO MODE
	THC INPUTS	12		-Z TRANSLATION COMMANDED
		11		+Z TRANSLATION COMMANDED
		10		-Y TRANSLATION COMMANDED
		9		+Y TRANSLATION COMMANDED
		8		-X TRANSLATION COMMANDED
		7		+X TRANSLATION COMMANDED
	RHC INPUTS	6		-ROLL COMMANDED
		5		+ROLL COMMANDED
		4		-YAW COMMANDED
		3		+YAW COMMANDED
		2		-PITCH COMMANDED
		1		+PITCH COMMANDED
94A	CHANNEL 32	BIT	SET	RESET
		15	NOT ASSIGNED - SHOULD BE ZERO	
		14		PROCEED KEY IS DEPRESSED
		13	NOT ASSIGNED - SHOULD BE ZERO	
		12	NOT ASSIGNED - SHOULD BE ZERO	
		11		LM ATTACHED
		10	NOT ASSIGNED - SHOULD BE ZERO	
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NOT ASSIGNED - SHOULD BE ZERO	
	MINIMUM IMPULSE CONTROLLER INPUTS	6		-ROLL COMMANDED
		5		+ROLL COMMANDED
		4		-YAW COMMANDED
		3		+YAW COMMANDED
		2		-PITCH COMMANDED
		1		+PITCH COMMANDED
94B	CHANNEL 33	BIT	SET	RESET
		15		COMPUTER OSCILLATOR HAS FAILED
		14		CMC WARNING HAS OCCURRED
		13		PIPA FAIL HAS OCCURRED
		12		TELEMETRY DOWNLINK IS TOO FAST
		11		UPLINK IS TOO FAST
		10	BLOCK UPLINK SWITCH IN NORMAL POSITION	BLOCK UPLINK SWITCH IN BLOCK POSITION
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NOT ASSIGNED - SHOULD BE ZERO	
		6	NOT ASSIGNED - SHOULD BE ZERO	
		5	OPTICS MODE SWITCH IN MANUAL POSITION	OPTICS MODE SWITCH IN COMPUTER POSITION
		4	OPTICS ZERO SWITCH IN NORMAL POSITION	OPTICS ZERO SWITCH IN ZERO POSITION
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	RANGE UNIT DATA NO GOOD	RANGE UNIT DATA GOOD
		1	NOT ASSIGNED - SHOULD BE ZERO	

ORBITAL NAVIGATION - Concluded

TRANSMITTED IN PROGRAM 22

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
95A 95B 96A 96B 97A 97B 98A 98B 99A 99B 100A 100B	SPARES	

ENTRY AND UPDATE

TRANSMITTED IN PROGRAMS 27,62,63,64,65,66,67

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
1A	LIST ID	$(77776)_8$ INDICATES ENTRY AND UPDATE LIST BEING TRANSMITTED.
1B	SYNC BITS	$(77340)_8$ INDICATES DATA TO FOLLOW
2A 2B	R_X X COMPONENT OF VEHICLE POSITION VECTOR	CSM VEHICLE STATE VECTOR AND TIME
3A 3B	R_Y Y COMPONENT OF VEHICLE POSITION VECTOR	
4A 4B	R_Z Z COMPONENT OF VEHICLE POSITION VECTOR	
5A 5B	V_X X COMPONENT OF VEHICLE VELOCITY VECTOR	
6A 6B	V_Y Y COMPONENT OF VEHICLE VELOCITY VECTOR	
7A 7B	V_Z Z COMPONENT OF VEHICLE VELOCITY VECTOR	
8A 8B	T_{SV} TIME TAG FOR $\overline{R}$ AND $\overline{V}$	
9A 9B 10A	CDUX CDUY CDUZ	X, Y, AND Z CDU INPUT COUNTERS. READ THE IMU COUNTERS ZEROED DURING ZERO ENCODE MODE (IMODES 33 BIT 5 = 1)
10B	CDUT	TRUNNION CDU INPUT COUNTER
11A 11B	$ADOT_X$	MEASURED BODY RATES ABOUT THE X, Y, AND Z CONTROL AXES ANY TIME THE RCS DAP IS ON
12A 12B	$ADOT_Y$	
13A 13B	$ADOT_Z$	
14A 14B 15A	AK AK2 AK3	VEHICLE ATTITUDE ERRORS (RPY) SENT TO FDAI. DURING RCS DAP OPERATION EITHER TOTAL ATTITUDE OR DAP FOLLOWING ERROR IS DISPLAYED. (DET BY FLAGWORD 0 BIT 9)
15B	RCSFLAGS	

BIT	SET	RESET
15	NOT USED - SHOULD BE ZERO	
14	RATE FILTER NOT INITIALIZED	RATE FILTER INITIALIZED
13	ROLL RATE DAMPING REQUIRED	
12	PITCH RATE DAMPING REQUIRED	
11	YAW RATE DAMPING REQUIRED	
10	-ROLL RHC INPUT	
9	+ROLL RHC INPUT	

TRANSMITTED IN PROGRAMS 27,62,63,64,65,66,67

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
15B	RCSFLAGS	BIT 8: SET: -YAW RHC INPUT; RESET:
		BIT 7: SET: +YAW RHC INPUT; RESET:
		BIT 6: SET: -PITCH RHC INPUT; RESET:
		BIT 5: SET: +PITCH RHC INPUT; RESET:
		BIT 4: SET: COMPUTE AK'S (ATTITUDE ERRORS); RESET: PERFORM NEEDLER TO DISPLAY AK'S
		BIT 3: 0 = 3RD PASS THROUGH; 0 = 2ND PASS THROUGH; 1 = INITIAL PASS THROUGH
		BIT 2: 0 = NEEDLER; 1 = NEEDLER; 1 = NEEDLER
		BIT 1: RESET: INITIALIZE T_6 PROGRAM
16A 16B 17A	$THETAD_X$ $THETAD_Y$ $THETAD_Z$	X, Y, AND Z REFERENCE CDU ANGLES FOR THE ATTITUDE HOLD ROUTINE. INTERMEDIATE DESIRED CDU ANGLES FOR AUTO MANEUVER ROUTINE.
17B	$DELCDU_X$	MOST SIGNIFICANT HALF OF X INCREMENTAL GIMBAL ANGLE USED IN AUTOMATIC MANEUVERS
18A	CMDAPMOD	ENTRY DAP MODE CONTROL USED TO CONTROL BRANCHING IN ENTRY DAP
18B	PREL	ROLL ANGULAR BODY RATE DURING ENTRY
19A	QREL	PITCH ANGULAR BODY RATE DURING ENTRY
19B	RREL	YAW ANGULAR BODY RATE DURING ENTRY
20A 20B	L/D1	DESIRED LIFT TO DRAG RATIO
21A 21B 22A 22B 23A 23B 24A 24B 25A 25B 26A 26B 27A 27B 28A 28B 29A 29B 30A 30B	UPBUFF UPBUFF+1 UPBUFF+2 UPBUFF+3 UPBUFF+4 UPBUFF+5 UPBUFF+6 UPBUFF+7 UPBUFF+8 UPBUFF+9 UPBUFF+10 UPBUFF+11 UPBUFF+12 UPBUFF+13 UPBUFF+14 UPBUFF+15 UPBUFF+16 UPBUFF+17 UPBUFF+18 UPBUFF+19	A 20 LOCATION BUFFER USED TO CONTAIN UPLINKED WORDS AS THEY ARE COMPLETED DURING P27
31A	COMPNUMB	USED IN P27 TO INDICATE THE TOTAL NUMBER OF UPLINK WORDS TO BE RECEIVED

ENTRY AND UPDATE - Continued

TRANSMITTED IN PROGRAMS 27,62,63,64,65,66,67

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
31B	UPOLDMOD	INDICATES THE MAJOR MODE INTERRUPTED BY P27		
32A	UPVERB	CONTAINS INFORMATION WHICH INDICATES WHICH VERB INITIATED P27		
32B	UPCOUNT	INDICATES THE TOTAL NUMBER OF WORDS RECEIVED BY P27		
33A	PAXERRI	ROLL ERROR FOR ENTRY DAP		
33B	ROLLTM	VALUE OF ROLL ANGLE FOR ENTRY DAP		
34A 34B	LATANG	LATERAL RANGE		
35A 35B	RDOT	ATTITUDE RATE		
36A 36B	THETAH	DESIRED RANGE		
37A 37B	LAT(SPL)	LATITUDE OF THE SPLASHDOWN SITE		
38A 38B	LNG(SPL)	LONGITUDE OF THE SPLASHDOWN SITE		
39A	ALFA/180	PITCH ATTITUDE ANGLE		
39B	BETA/180	YAW ATTITUDE ANGLE		
40A	FLAGWORD 0	BIT	SET	RESET
	CPHIFLAG	15	OUTPUT OF CALCGA IS CPHIX	OUTPUT OF CALCGA IS THETAD
	JSWITCH	14	INTEGRATION OF W MATRIX	INTEGRATION OF STATE VECTOR
	MIDFLAG	13	INTEGRATION WITH SOLAR PERTURBATIONS	INTEGRATION WITHOUT SOLAR PERTURBATIONS
	MOONFLAG	12	MOON IS SPHERE OF INFLUENCE	EARTH IS SPHERE OF INFLUENCE
	NORFHOR	11	NOT USED IN ENTRY AND UPDATE LIST	
	ZMEASURE	10	NOT USED IN ENTRY AND UPDATE LIST	
	NEEDLFLG	9	TOTAL ATTITUDE ERROR DISPLAYED	A/P FOLLOWING ERROR DISPLAYED
	IMUSE	8	IMU IN USE	IMU NOT IN USE
	RNDVZFLG	7	NOT USED IN ENTRY AND UPDATE LIST	
	R53FLAG	6	NOT USED IN ENTRY AND UPDATE LIST	
	F2RTE	5	NOT USED IN ENTRY AND UPDATE LIST	
	TRUNFLAG	4	NOT USED IN ENTRY AND UPDATE LIST	
	FREEFLAG	3	USED TO CONTROL INTERNAL SUBROUTINE PERFORMANCE	
	B29FLAG	2	NOT USED	
	KFLAG	1	NOT USED IN ENTRY AND UPDATE LIST	

TRANSMITTED IN PROGRAMS 27,62,63,64,65,66,67

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
40B	FLAGWORD 1	BIT	SET	RESET
	NJETSFLG	15	NOT USED IN ENTRY AND UPDATE LIST	
	STIKFLAG	14	RHC CONTROL OF RCS	CMC CONTROL OF RCS
	ERADFLAG	13	NOT USED IN ENTRY AND UPDATE LIST	
		12	NOT USED	
	ENG2FLAG	11	NOT USED IN ENTRY AND UPDATE LIST	
	TARG1FLG	10	NOT USED IN ENTRY AND UPDATE LIST	
	TARG2FLG	9	NOT USED IN ENTRY AND UPDATE LIST	
	R23FLG	9	NOT USED IN ENTRY AND UPDATE LIST	
	VEHUPFLG	8	NOT USED IN ENTRY AND UPDATE LIST	
	UPDATFLG	7	NOT USED IN ENTRY AND UPDATE LIST	
	IDLEFAIL	6	NOT USED IN ENTRY AND UPDATE LIST	
	TRACKFLG	5	NOT USED IN ENTRY AND UPDATE LIST	
		4	NOT USED	
	SLOPESW	3	NOT USED IN ENTRY AND UPDATE LIST	
	GUESSW	2	NOT USED IN ENTRY AND UPDATE LIST	
	AVEGFLAG	1	NOT USED IN ENTRY AND UPDATE LIST	
41A	FLAGWORD 2	BIT	SET	RESET
	DRIFTFLG	15	NOT USED IN ENTRY AND UPDATE LIST	
	R21MARK	14	NOT USED IN ENTRY AND UPDATE LIST	
	22DSPFLG	13	NOT USED IN ENTRY AND UPDATE LIST	
		12	NOT USED	
	STERRSW	11	NOT USED IN ENTRY AND UPDATE LIST	
	CYCLESW	10	NOT USED IN ENTRY AND UPDATE LIST	
	IMPULSW	9	NOT USED IN ENTRY AND UPDATE LIST	
	XDELVFLG	8	NOT USED IN ENTRY AND UPDATE LIST	
	ETPIFLAG	7	NOT USED IN ENTRY AND UPDATE LIST	
	OPTNSW	7	NOT USED IN ENTRY AND UPDATE LIST	
	FINALFLG	6	NOT USED IN ENTRY AND UPDATE LIST	
	AVFLAG	5	NOT USED IN ENTRY AND UPDATE LIST	
	PFRATFLG	4	NOT USED IN ENTRY AND UPDATE LIST	
	CALCMAN3	3	NOT USED	
	CALCMAN2	2	NOT USED IN ENTRY AND UPDATE LIST	
	NODOFLAG	1	V37 NOT PERMITTED	V37 PERMITTED
41B	FLAGWORD 3	BIT	SET	RESET
		15	NOT USED	
	GLOKFAIL	14	GIMBAL LOCK HAS OCCURRED	NOT IN GIMBAL LOCK
	REFSMFLG	13	NOT USED IN ENTRY AND UPDATE LIST	
	LUNAFLAG	12	NOT USED IN ENTRY AND UPDATE LIST	
	P22MKFLG	11	NOT USED IN ENTRY AND UPDATE LIST	
	VFLAG	10	NOT USED IN ENTRY AND UPDATE LIST	
	ONMONFLG	9	NOT USED IN ENTRY AND UPDATE LIST	
	PRECIFLG	8	CSMPREC OR LEMPREC CALLED	INTEGRV OR INTEGRVS CALLED
	CULTFLAG	7	NOT USED IN ENTRY AND UPDATE LIST	
	ORBWFLAG	6	W MATRIX VALID FOR ORBITAL INTEGRATION	W MATRIX INVALID FOR ORBITAL INTEGRATION
	STATEFLG	5	PERMANENT STATE VECTOR UPDATED	PERMANENT STATE VECTOR NOT UPDATED
	INTYPFLG	4	CONIC INTEGRATION	ENCKE INTEGRATION
	VINTFLAG	3	CSM STATE VECTOR BEING INTEGRATED	LM STATE VECTOR BEING INTEGRATED
	D6OR9FLG	2	DIMENSION OF W IS 9 FOR INTEGRATION	DIMENSION OF W IS 6 FOR INTEGRATION
	DIMOFLAG	1	W MATRIX IS TO BE USED	W MATRIX IS NOT TO BE USED

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
42A	FLAGWORD 4	BIT	SET	RESET
	MRKIDFLG	15	MARK DISPLAY IN ENDIDLE	NO MARK DISPLAY IN ENDIDLE
	PRIODFLG	14	PRIORITY DISPLAY IN ENDIDLE	NO PRIORITY DISPLAY IN ENDIDLE
	NRMIDFLG	13	NORMAL DISPLAY IN ENDIDLE	NO NORMAL DISPLAY IN ENDIDLE
	PDSPFLAG	12	CAN NOT INTERRUPT PRIORITY DISPLAY	
	MWAITFLG	11	HIGHER PRIORITY DISPLAY OPERATING WHEN MARK DISPLAY INITIATED	NO HIGHER PRIORITY DISPLAY OPERATING WHEN MARK DISPLAY INITIATED
	NWAITFLG	10	HIGHER PRIORITY DISPLAY OPERATING WHEN NORMAL DISPLAY INITIATED	NO HIGHER PRIORITY DISPLAY OPERATING WHEN NORMAL DISPLAY INITIATED
	MRKNVFLG	9	ASTRONAUT USING KEYBOARD WHEN MARK DISPLAY INITIATED	ASTRONAUT NOT USING KEYBOARD WHEN MARK DISPLAY INITIATED
	NRMNVFLG	8	ASTRONAUT USING KEYBOARD WHEN NORMAL DISPLAY INITIATED	ASTRONAUT NOT USING KEYBOARD WHEN NORMAL DISPLAY INITIATED
	PRONVFLG	7	ASTRONAUT USING KEYBOARD WHEN PRIORITY DISPLAY INITIATED	ASTRONAUT NOT USING KEYBOARD WHEN PRIORITY DISPLAY INITIATED
	PINBRFLG	6	ASTRONAUT HAS INTERFERED WITH EXISTING DISPLAY	ASTRONAUT HAS NOT INTERFERED WITH EXISTING DISPLAY
	MRUPTFLG	5	MARK DISPLAY INTERRUPTED BY PRIORITY DISPLAY	MARK DISPLAY NOT INTERRUPTED BY PRIORITY DISPLAY
	NRUPTFLG	4	NORMAL DISPLAY INTERRUPTED BY PRIORITY OR MARK DISPLAY	NORMAL DISPLAY NOT INTERRUPTED BY PRIORITY OR MARK DISPLAY
	MKOVFLAG	3	MARK DISPLAY OVER NORMAL	NO MARK DISPLAY OVER NORMAL
		2	NOT USED	
	XDSPFLAG	1	MARK DISPLAY NOT TO BE INTERRUPTED	
42B	FLAGWORD 5	BIT	SET	RESET
	DSKYFLAG	15	DISPLAYS SENT TO DSKY	NO DISPLAYS TO DSKY
		14	NOT USED	
		13	NOT USED	
	V59FLAG	12	NOT USED IN ENTRY AND UPDATE LIST	
	INCORFLG	11	NOT USED IN ENTRY AND UPDATE LIST	
	PRFTRKAT	10	NOT USED IN ENTRY AND UPDATE LIST	
	DMENFLG	9	NOT USED IN ENTRY AND UPDATE LIST	
	COMPUTER	8	COMPUTER IS CMC	COMPUTER IS LGC
	ENGONFLG	7	NOT USED IN ENTRY AND UPDATE LIST	
	3AXISFLG	6	NOT USED IN ENTRY AND UPDATE LIST	
	GRRBKFLG	5	NOT USED IN ENTRY AND UPDATE LIST	
	R60FLAG	4	NOT USED IN ENTRY AND UPDATE LIST	
	SOLNSW	3	NOT USED IN ENTRY AND UPDATE LIST	
	MGLVFLAG	2	NOT USED IN ENTRY AND UPDATE LIST	
	RENDWFLG	1	NOT USED IN ENTRY AND UPDATE LIST	

ENTRY AND UPDATE - Continued

TRANSMITTED IN PROGRAMS 27,62,63,64,65,66,67

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
43A	FLAGWORD 6	BIT	SET	RESET
	DAPBIT1	15	0 NO DAP OR 0 ENTRY	0 CSM RCS 1 DAP
		14		1 TVC DAP 0 SATURN DAP 1
	STRULLSW	13	DO STEERULL	DO ULLAGE ONLY
	ENTRYDSP	13	DO ENTRY DISPLAY VIA ENTRYVN	OMIT ENTRY DISPLAY
	CMDAPARM	12	ALLOW ENTRY FIRINGS AND CALCULATIONS	INHIBIT ENTRY FIRINGS AND CONTROL FUNCTIONS
	GAMDIFSW	11	CALCULATE GAMDOT	GAMDOT NOT TO BE CALCULATED
	GONEPAST	10	LATERAL CONTROL CALCULATIONS TO BE OMITTED	LATERAL CONTROL CALCULATIONS TO BE DONE
	RELVELSW	9	TARGETING USES EARTH VELOCITY	TARGETING USES INERTIAL VELOCITY
	EGSW	8	IN FINAL PHASE	NOT IN FINAL PHASE
	FIRSTPAS	7	NOT FIRST TIME IN HUNTEST	FIRST TIME IN HUNTEST
	HIND	6	INTEGRATING HUNTEST CALCULATIONS TO BE DONE AFTER RANGE PREDICTION	INTEGRATING OF HUNTEST CALCULATIONS TO BE OMITTED AFTER RANGE PREDICTION
	INRLSW	5	INITIAL ROLL V (LV) ATTITUDE NOT HELD	INITIAL ROLL V (LV) ATTITUDE HELD
	LATSW	4	DOWNLIFT NOT INHIBITED	DOWNLIFT INHIBITED
	.05GSW	3	DRAG OVER .05G	DRAG LESS THAN .05G
	CM/DSTBY	2	ENTRY DAP ACTIVATED	ENTRY DAP NOT ACTIVATED
	GYMDIFSW	1	CDU DIFFERENCES AND BODY RATES COMPUTED	CDU DIFFERENCES AND BODY RATES NOT COMPUTED
43B	FLAGWORD 7	BIT	SET	RESET
	TERMIFLG	15	NOT USED IN ENTRY AND UPDATE LIST	
	ITSWICH	14	NOT USED IN ENTRY AND UPDATE LIST	
	IGNFLAG	13	NOT USED IN ENTRY AND UPDATE LIST	
	ASTNFLAG	12	NOT USED IN ENTRY AND UPDATE LIST	
	TIMRFLAG	11	NOT USED IN ENTRY AND UPDATE LIST	
	NORMSW	10	UNIT NORMAL COMPUTED	UNIT NORMAL NOT COMPUTED
	RVSW	9	NOT USED IN ENTRY AND UPDATE LIST	
	GONEBY	8	PASSED TARGET	APPROACHING TARGET
	IDLEFLAG	7	NO DV MONITOR	CONNECT DV MONITOR
	V37FLAG	6	AVERAGE G (SERVICER) RUNNING	AVERAGE G (SERVICER) OFF
	NOUPFLAG	5	NOT USED IN ENTRY AND UPDATE LIST	
	UPLOCKFL	4	K-KBAR-K FAIL	NO K-KBAR-K FAIL
	VERIFLAG	3	CHANGED WHEN VERB 33 OCCURS AT END OF P27	
	ATTCHFLG	2	NOT USED IN ENTRY AND UPDATE LIST	
	TFFSW	1	CALCULATE TPERIGEE	CALCULATE TFF

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
44A	FLAGWORD 8	BIT	SET	RESET
	RPQFLAG	15	RPQ NOT COMPUTED	RPQ COMPUTED
		14	NOT USED	
	NEWIFLG	13	FIRST PASS THROUGH INTEGRATION	SUCCEEDING INTEGRATION OF INTEGRATION
	CMOONFLG	12	NOT USED IN ENTRY AND UPDATE LIST	
	LMOONFLG	11	NOT USED IN ENTRY AND UPDATE LIST	
	ADVTRK	10	NOT USED IN ENTRY AND UPDATE LIST	
	P39/79 SW	9	NOT USED IN ENTRY AND UPDATE LIST	
	SURFFLAG	8	NOT USED IN ENTRY AND UPDATE LIST	
	INFINFLG	7	NOT USED IN ENTRY AND UPDATE LIST	
	ORDERSW	6	NOT USED IN ENTRY AND UPDATE LIST	
	APSESW	5	NOT USED IN ENTRY AND UPDATE LIST	
	COGAFLAG	4	NOT USED IN ENTRY AND UPDATE LIST	
		3	NOT USED	
		2	NOT USED	
	360SW	1	NOT USED IN ENTRY AND UPDATE LIST	
44B	FLAGWORD 9	BIT	SET	RESET
	SWTOVER	15	NOT USED IN ENTRY AND UPDATE LIST	
	V67FLAG	14	NOT USED IN ENTRY AND UPDATE LIST	
	V82EMFLG	13	NOT USED IN ENTRY AND UPDATE LIST	
	MAXDBFLG	12	MAX DB SELECTED	MAX DB NOT SELECTED
	V94FLAG	11	NOT USED IN ENTRY AND UPDATE LIST	
	SAVECFLG	10	NOT USED IN ENTRY AND UPDATE LIST	
	VHFRFLAG	9	NOT USED IN ENTRY AND UPDATE LIST	
	SOURCFLG	8	NOT USED IN ENTRY AND UPDATE LIST	
	R22CAFLG	7	NOT USED	
	N22ORN17	6	COMPUTE TOTAL ATTITUDE ERRORS WRT N22 (V62)	COMPUTE TOTAL ATTITUDE ERRORS WRT N17 (V63)
	QUITFLAG	5	CAUSE INTEGRATION TO EXIT AT NEXT TIME STEP	ALLOW INTEGRATION TO CONTINUE
	R31FLAG	4	NOT USED IN ENTRY AND UPDATE LIST	
	MID1FLAG	3	INTEGRATE TO TDEC	INTEGRATE TO THE THEN-PRESENT TIME
	MIDAVFLG	2	INTEGRATION ENTERED FROM ONE OF MIDTOAV PORTALS	INTEGRATION WAS NOT ENTERED VIA MIDTOAV
	AVEMIDSW	1	AVETOMID CALLING FOR W MATRIX INTEGER DO NOT WRITE OVER RN, VN, PIPTIME	NO AVETOMID W INTEGER ALLOW SET UP OF RN, VN, PIPTIME
45A	DSPTAB	DISPLAY TABLE CODES FOR GENERATION OF DSKY NUMBERS		
45B	DSPTAB+1			
46A	DSPTAB+2			
46B	DSPTAB+3			
47A	DSPTAB+4			
47B	DSPTAB+5	USED TO INDICATE VERB-NOUN MAJOR MODE AND R1, R2, AND R3 DSIPLAYS		
48A	DSPTAB+6			
48B	DSPTAB+7			
49A	DSPTAB+8			
49B	DSPTAB+9			
50A	DSPTAB+10			
50B	DSPTAB+11	DISPLAY TABLE OF DSKY STATUS LIGHTS 60400_8 = PROGRAM CAUTION, 60200_8 = TRACKER WARNING 60020_8 = NO ATTITUDE, 60040_8 = GIMBAL LOCK		

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WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
51A 51B	TIME2, TIME1	COMPUTER CLOCK INDICATING ELAPSED TIME SINCE LIFTOFF
52A 52B	PIPTIME	THE TIME AT WHICH PIPA'S WERE LAST READ
53A 53B	DELVX	X, Y, AND Z PIPA 2 SECOND VALUES CORRECTED FOR SCALE FACTOR ERROR AND BIAS. UPDATED EVERY 2 SEC DURING AVERAGE G ROUTINE.
54A 54B	DELVY	
55A 55B	DELVZ	
56A 56B	TTE	TIME TO ARRIVAL AT EMS INTERFACE ALTITUDE
57A 57B	VIO	PREDICTED VELOCITY AT EMS INTERFACE ALTITUDE
58A 58B	VPRED	PREDICTED VELOCITY AT ALTITUDE OF 400,000 FEET ABOVE FISCHER RADIUS
59A 59B 60A	CDUX CDUY CDUZ	SAME AS 9A SAME AS 9B SAME AS 10A
60B	CDUT	SAME AS 10B
61A 61B	ADOTX	SAME AS 11A, 11B
62A 62B	ADOTY	SAME AS 12A, 12B
63A 63B	ADOTZ	SAME AS 13A, 13B
64A 64B 65A	AK AK1 AK2	SAME AS 14A SAME AS 14B SAME AS 15A
65B	RCSFLAGS	SAME AS 15B
66A 66B 67A	ERRORX ERRORY ERRORZ	INTERMEDIATE ATTITUDE ERRORS COMPUTED DURING CSM RCS DAP (DAP FOLLOWING ERRORS). ERRORS IN CONTROL COORDINATES AND ARE LOADED INTO AK'S FOR FDAI DISPLAY WHEN FW0 BIT 9=0.

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WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE
67B	$THETAD_X$	SAME AS 16A
68A	$THETAD_Y$	SAME AS 16B
68B	$THETAD_Z$	SAME AS 17A
69A	CMDAPMOD	SAME AS 18A
69B	PREL	SAME AS 18B
70A	QREL	SAME AS 19A
70B	RREL	SAME AS 19B
71A	UPBUFF	SAME AS 21A THROUGH 30B
71B	UPBUFF+1	
72A	UPBUFF+2	
72B	UPBUFF+3	
73A	UPBUFF+4	
73B	UPBUFF+5	
74A	UPBUFF+6	
74B	UPBUFF+7	
75A	UPBUFF+8	
75B	UPBUFF+9	
76A	UPBUFF+10	
76B	UPBUFF+11	
77A	UPBUFF+12	
77B	UPBUFF+13	
78A	UPBUFF+14	
78B	UPBUFF+15	
79A	UPBUFF+16	
79B	UPBUFF+17	
80A	UPBUFF+18	
80B	UPBUFF+19	
81A	LEMMASS	MASS OF THE LM
81B	CSMMASS	MASS OF THE CSM
82A	DAPDATR1 LOADED WITH V48N46E	BITS
		15 — NOT USED - SHOULD BE ZERO
		14 — 0 NO, 1 LM — 0 LM, 1 SATURN
		13 — 0 DAP, 1 OFF — 0 ON, 1 DAP
		12 — NOT USED - SHOULD BE ZERO
		11 — NOT USED - SHOULD BE ZERO
		10 — X TRANSLATIONS USING QUADS AC 0 - DO NOT USE QUADS AC 1 - USE QUADS AC
		9 — NOT USED - SHOULD BE ZERO
		8 — NOT USED - SHOULD BE ZERO
		7 — X TRANSLATIONS USING QUADS BD 0 - DO NOT USE QUADS BD 1 - USE QUADS BD
		6 — NOT USED - SHOULD BE ZERO
		5 — NOT USED - SHOULD BE ZERO
		4 — ANGULAR DEADBAND FOR ATTITUDE HOLD AND AUTOMATIC MANEUVERS 0 - ±0.5° DEADBAND 1 - ±5.0° DEADBAND

TRANSMITTED IN PROGRAMS 27,62,63,64,65,66,67

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE	
82A	DAPDATR1	BITS	
		3	NOT USED - SHOULD BE ZERO
		2	SPECIFY MANEUVER RATE: 0 0 1 1 / 0 1 0 1 / .05° .2° .5° 4.0° / SEC SEC SEC SEC
		1	
82B	DAPDATR2	BITS	
		15	NOT USED - SHOULD BE ZERO
		14	NOT USED - SHOULD BE ZERO
		13	ROLL JET SELECTION 0 - USE QUAD AC FOR ROLL MANEUVERS 1 - USE QUAD BD FOR ROLL MANEUVERS
		12	NOT USED - SHOULD BE ZERO
		11	NOT USED - SHOULD BE ZERO
		10	A QUAD FAIL 1 - QUAD A IS OK 1 - QUAD A FAILED
		9	NOT USED - SHOULD BE ZERO
		8	NOT USED - SHOULD BE ZERO
		7	B QUAD FAIL 0 - QUAD B IS OK 1 - QUAD B FAILED
		6	NOT USED - SHOULD BE ZERO
		5	NOT USED - SHOULD BE ZERO
		4	C QUAD FAIL 0 - QUAD C IS OK 1 - QUAD C FAILED
		3	NOT USED - SHOULD BE ZERO
		2	NOT USED - SHOULD BE ZERO
		1	D QUAD FAIL 0 - QUAD D IS OK 1 - QUAD D FAILED
83A	ROLLTM	SAME AS 33B	
83B	ROLLC	ROLL COMMAND	
84A	OPTMODES	BIT	SET / RESET
		15	NOT ASSIGNED - SHOULD BE ZERO
		14	NOT ASSIGNED - SHOULD BE ZERO
		13	NOT ASSIGNED - SHOULD BE ZERO
		12	NOT ASSIGNED - SHOULD BE ZERO
		11	NOT ASSIGNED - SHOULD BE ZERO
		10	INDICATES OPTICS HAS BEEN ZEROED SINCE LAST FRESH START / ALARM 120g WILL BE GENERATED IF ATTEMPT IS MADE TO ZERO OPTICS
		9	OPTICS MODE SWITCH IN COMPUTER POSITION / RESET BY FRESH START MODE OTHER THAN CMC
		8	NOT ASSIGNED - SHOULD BE ZERO
		7	OPTICS CDU FAIL PRESENTLY / NO OPTICS CDU FAIL PRESENTLY
		6	NOT ASSIGNED - SHOULD BE ZERO
		5	OPTICS MODE SWITCH NOT IN CMC POSITION / OPTICS MODE SWITCH IN CMC POSITION
		4	OPTICS ZERO SWITCH NOT IN ZERO POSITION / OPTICS ZERO SWITCH IN ZERO POSITION
			(BIT 4 AND 5 = 1'S OPTICS IN MANUAL MODE)

TRANSMITTED IN PROGRAMS 27,62,63,64,65,66,67

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
84A	OPTMODES	BIT	SET	RESET
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	NOT ASSIGNED - SHOULD BE ZERO	
		1	NOT ASSIGNED - SHOULD BE ZERO	
84B	HOLDFLAG	USED TO DETERMINE NATURE OF ATTITUDE HOLD CONTROL IN CSM RCS DAP. IF >+0 PERFORM ATTITUDE HOLD ABOUT ANGLES CONTAINED IN CDU INPUT COUNTERS (PRESENT IMU ANGLES). IF = +0 PERFORM ATTITUDE HOLD ABOUT EXISTING REFERENCE. IF <+0 AUTOMATIC STEERING IS TO BE PERFORMED.		
85A 85B	WBODY	DESIRED BODY ROLL RATE ABOUT CONTROL AXIS		
86A 86B	WBODY1	DESIRED BODY PITCH RATE ABOUT CONTROL AXIS		
87A 87B	WBODY2	DESIRED BODY YAW RATE ABOUT CONTROL AXIS		
88A	REDOCTR	INDICATES THE NUMBER OF RESTARTS WHICH HAVE OCCURRED SINCE LAST FRESH START		
88B 89A 89B	THETAD THETAD+1 THETAD+2	FINAL DESIRED X CDU ANGLE FINAL DESIRED Y CDU ANGLE FINAL DESIRED Z CDU ANGLE		
90A	IMODES30	BIT	SET	RESET
		15	IMU TEMPERATURE OUT OF LIMITS	IMU TEMPERATURE WITHIN LIMITS
		14	NO ISS TURN ON REQUEST PRESENT	ISS TURN ON REQUEST PRESENT
		13	NO IMU FAIL	IMU FAIL HAS OCCURRED
		12	NO ICDU FAIL	ICDU FAIL HAS OCCURRED
		11	NO IMU CAGE COMMANDED	IMU CAGE HAS BEEN COMMANDED
		10	NO PIPA FAIL	PIPA FAIL HAS OCCURRED
		9	IMU NOT OPERATING	IMU OPERATING
		8	USED IN IMU TURN-ON SEQUENCING MOST LIKELY ZERO	
		7	SAME AS BIT 8	
		6	IMU INITIALIZATION BEING ACCOMPLISHED	IMU NOT IN INITIALIZATION
		5	INHIBIT ALARM 2128 IF PIPA FAIL OCCURS	DO NOT INHIBIT ALARM 2128 IF PIPA FAIL OCCURS
		4	INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF IMU FAIL OCCURS	DO NOT INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF IMU FAIL OCCURS
		3	INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF ICDU FAIL OCCURS	DO NOT INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF ICDU FAIL OCCURS

TRANSMITTED IN PROGRAMS 27,62,63,64,65,66,67

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
90A	IMODES30	BIT	SET	RESET
		2	TURN-ON DELAY FAILURE (ALARM 2078)	NO TURN-ON DELAY FAILURE
		1	INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF A PIPA FAIL OCCURS	DO NOT INHIBIT ISS WARNING LAMP FROM BEING TURNED ON IF A PIPA FAIL OCCURS
90B	IMODES33	BIT	SET	RESET
		15	NOT ASSIGNED - SHOULD BE ZERO	
		14		
		13	PIPA FAIL HAS NOT OCCURRED	PIPA FAIL HAS OCCURRED
		12	TELEMETRY DOWNLINK OK	TELEMETRY DOWNLINK IS TOO FAST
		11	UPLINK IS OK	UPLINK IS TOO FAST
		10	NOT ASSIGNED - SHOULD BE ZERO	
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NOT ASSIGNED - SHOULD BE ZERO	
		6	IMU IN COARSE ALIGN OR ZEROING MODE	IMU NOT IN COARSE ALIGN OR ZEROING MODE
		5	IMU IN ZEROING ROUTINE	IMU NOT IN ZEROING ROUTINE
		4	NOT ASSIGNED - SHOULD BE ZERO	
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	NOT USED	
		1	LAMP TEST IN PROGRESS (V35)	LAMP TEST NOT IN PROGRESS
91A	CHANNEL 11	BIT	SET	RESET
		15	NOT ASSIGNED - SHOULD BE ZERO	
		14	NOT ASSIGNED - SHOULD BE ZERO	
		13	SPS ENGINE ON COMMAND	
		12	NOT ASSIGNED - SHOULD BE ZERO	
		11	NOT ASSIGNED - SHOULD BE ZERO	
		10	ERROR RESET KEYCODE RECEIVED FROM UPLINK OR DSKY	
		9	INDICATES AVERAGE G ROUTINE IS RUNNING	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	OPERATOR ERROR HAS OCCURRED	
		6	VERB-NOUN FLASHER ON	
		5	KEY RELEASE LAMP ON	
		4	IMU TEMPERATURE IS OUT OF LIMITS	
		3	UPLINK ACTIVITY LAMP ON	
		2	COMPUTER ACTIVITY LAMP ON	
		1	ISS WARNING LAMP ON	

TRANSMITTED IN PROGRAMS 27,62,63,64,65,66,67

WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
91B	CHANNEL 12	BIT	SET	RESET
		15	TURN-ON DELAY - COMPLETE	
		14	S-IVB CUTOFF COMMAND	
		13	S-IVB INJECTION SEQUENCING START	
		12	NOT ASSIGNED - SHOULD BE ZERO	
		11	DISENGAGE OPTICS DAC	
		10	ZERO OPTICS COMMAND	
		9	S-IVB TAKEOVER ENABLE	
		8	TVC ENABLE	
		7	NOT ASSIGNED - SHOULD BE ZERO	
		6	IMU CDU ERROR COUNTER ENABLE	
		5	IMU CDU ZERO COMMAND	
		4	IMU COARSE ALIGN ENABLE	
		3	STAR TRACKERS ON	
		2	OPTICS CDU ERROR COUNTER ENABLE	
		1	OPTICS CDU ZERO COMMAND	
92A	CHANNEL 13	BIT	SET	RESET
		15	T6RUPT ENABLE	
		14	RESET TRAP 32	
		13	RESET TRAP 31-B	
		12	RESET TRAP 31-A	
		11	ENABLE STANDBY BUTTON	
		10	LAMP TEST BEING PERFORMED	
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	BMAG OUTPUT ENABLE	
		7	WORD ORDER CODE FOR WORDS 2-50, 52-100	WORD ORDER CODE FOR WORDS 1 AND 51
		6	BLOCK UPLINK	
		5	INHIBIT UPLINK, ENABLE CROSSLINK	
		4	RANGE UNIT ACTIVITY	
		3	RANGE UNIT SELECT a	
		2	RANGE UNIT SELECT b	
		1	RANGE UNIT SELECT c	
92B	CHANNEL 14	BIT	SET	RESET
		15	XCDU DRIVE ENABLE	
		14	YCDU DRIVE ENABLE	
		13	ZCDU DRIVE ENABLE	
		12	TRUNNION CDU DRIVE ENABLE	
		11	SHAFT CDU DRIVE ENABLE	
		10	GYRO TORQUING ENABLE	
		9	NEGATIVE GYRO TORQUE	POSITIVE GYRO TORQUE
		8	GYRO SELECT 0 = NO GYRO, 1 = X GYRO	0 = NO GYRO, 1 = Y GYRO
		7		0 = NO GYRO, 1 = Z GYRO
		6	GYRO PULSE TORQUE POWER SUPPLY ENABLED	

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WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
92B	CHANNEL 14	BIT	SET	RESET
		5	NOT USED - SHOULD BE ZERO	
		4	NOT ASSIGNED - SHOULD BE ZERO	
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	NOT ASSIGNED - SHOULD BE ZERO	
		1	NOT USED - SHOULD BE ZERO	
93A	CHANNEL 30	BIT	SET	RESET
		15	IMU TEMPERATURE OUT OF LIMITS	IMU TEMPERATURE WITHIN LIMITS
		14	ISS OFF	ISS ON OR COMMANDED ON
		13	NO IMU FAIL	IMU FAILURE
		12	NO ICDU FAIL	ICDU FAILURE
		11	NO IMU CAGE COMMANDED	IMU CAGE COMMANDED
		10		LAUNCH VEHICLE GUIDANCE SWITCH IN CMC POSITION
		9	IMU NOT OPERATING	IMU OPERATING
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NO OCDU FAIL	OCDU FAILURE
		6	NOT USED	
		5	LIFTOFF HAS NOT OCCURRED	LIFTOFF HAS OCCURRED
		4	S-IVB ATTACHED	S-IVB SEPARATED
		3	SPS NOT READY	SPS READY
		2	CM/SM ATTACHED	CM/SM SEPARATED
		1	ULLAGE THRUST NOT PRESENT FOR S-IVB	ULLAGE THRUST PRESENT FROM S-IVB
93B	CHANNEL 31	BIT	SET	RESET
		15	COMPUTER NOT IN CONTROL OF SAPCECRAFT	COMPUTER IN CONTROL OF SPACECRAFT
		14	CSM RCS 0 / DAP MODE 0 } ILLEGAL	0 FREE 1 HOLD 1 AUTO / 1 MODE 0 MODE 1 MODE
		13		
	THC INPUTS	12		-Z TRANSLATION COMMANDED
		11		+Z TRANSLATION COMMANDED
		10		-Y TRANSLATION COMMANDED
		9		+Y TRANSLATION COMMANDED
		8		-X TRANSLATION COMMANDED
		7		+X TRANSLATION COMMANDED
	RHC INPUTS	6		-ROLL COMMANDED
		5		+ROLL COMMANDED
		4		-YAW COMMANDED
		3		+YAW COMMANDED
		2		-PITCH COMMANDED
		1		+PITCH COMMANDED

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WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
94A	CHANNEL 32	BIT	SET	RESET
		15	NOT ASSIGNED - SHOULD BE ZERO	
		14		PROCEED KEY IS DEPRESSED
		13	NOT ASSIGNED - SHOULD BE ZERO	
		12	NOT ASSIGNED - SHOULD BE ZERO	
		11		LM ATTACHED
		10	NOT ASSIGNED - SHOULD BE ZERO	
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NOT ASSIGNED - SHOULD BE ZERO	
	MINIMUM IMPULSE CONTROLLER INPUTS	6		-ROLL COMMANDED
		5		+ROLL COMMANDED
		4		-YAW COMMANDED
		3		+YAW COMMANDED
		2		-PITCH COMMANDED
		1		+PITCH COMMANDED
94B	CHANNEL 33	BIT	SET	RESET
		15		COMPUTER OSCILLATOR HAS FAILED
		14		CMC WARNING HAS OCCURRED
		13		PIPA FAIL HAS OCCURRED
		12		TELEMETRY DOWNLINK IS TOO FAST
		11		UPLINK IS TOO FAST
		10	BLOCK UPLINK SWITCH IN NORMAL POSITION	BLOCK UPLINK SWITCH IN BLOCK POSITION
		9	NOT ASSIGNED - SHOULD BE ZERO	
		8	NOT ASSIGNED - SHOULD BE ZERO	
		7	NOT ASSIGNED - SHOULD BE ZERO	
		6	NOT ASSIGNED - SHOULD BE ZERO	
		5	OPTICS MODE SWITCH IN MANUAL POSITION	OPTICS MODE SWITCH IN COMPUTER POSITION
		4	OPTICS ZERO SWITCH IN NORMAL POSITION	OPTICS ZERO SWITCH IN ZERO POSITION
		3	NOT ASSIGNED - SHOULD BE ZERO	
		2	RANGE UNIT DATA NO GOOD	RANGE UNIT DATA GOOD
		1	NOT ASSIGNED - SHOULD BE ZERO	
95A 95B	RSBBQ	VALUE OF BBANK AND Q REGISTERS AT THE TIME OF A RESTART		
96A	CADRFLSH	VALUE OF RETURN ADDRESS INFORMATION FOR LAST REQUESTED PRIORITY DISPLAY		
96B	CADRFLSH+1	VALUE OF RETURN ADDRESS INFORMATION FOR LAST REQUESTED MARK		
97A	CADRFLSH+2	VALUE OF RETURN ADDRESS INFORMATION FOR LAST NORMAL DISPLAY REQUESTED		

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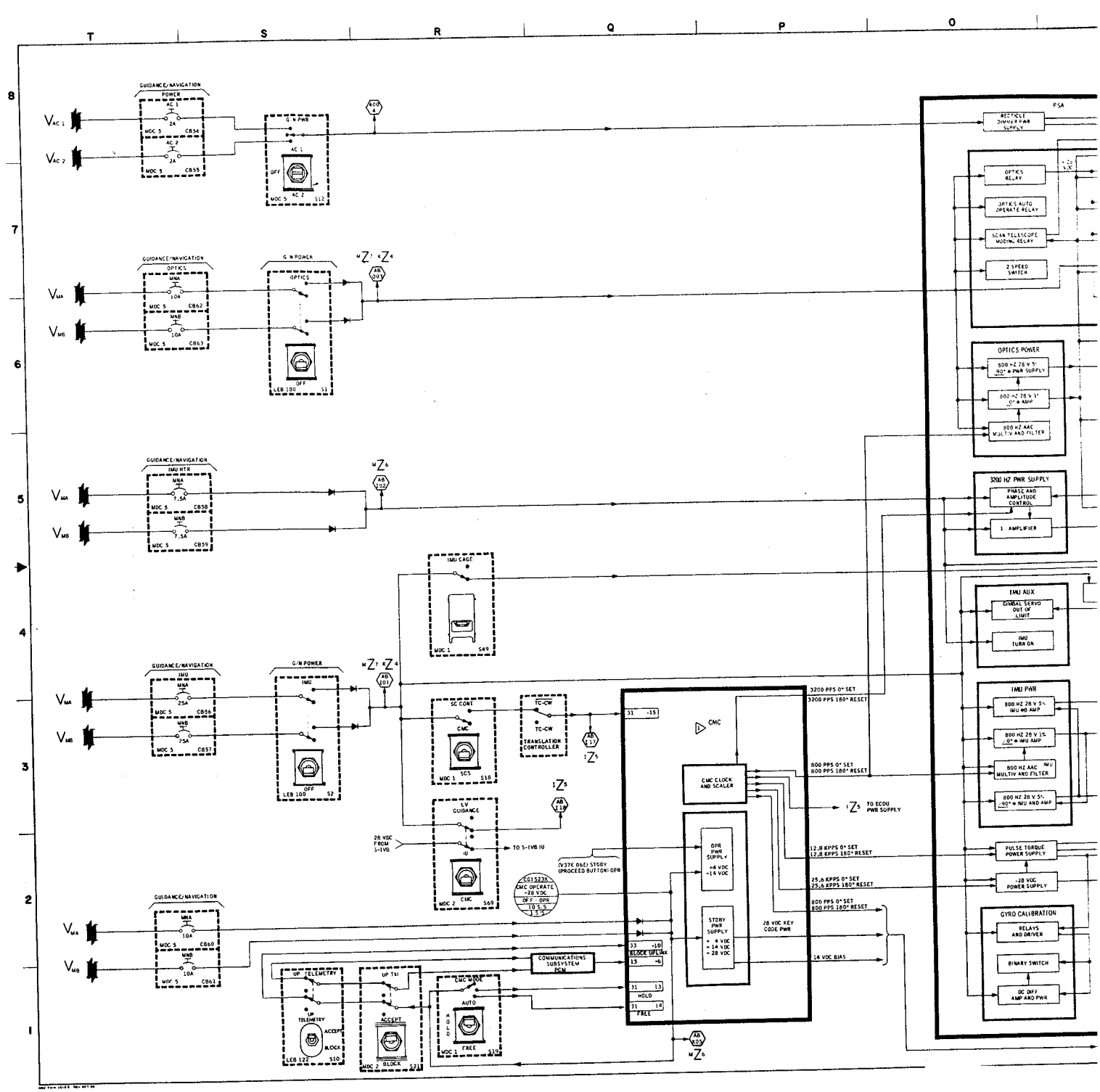
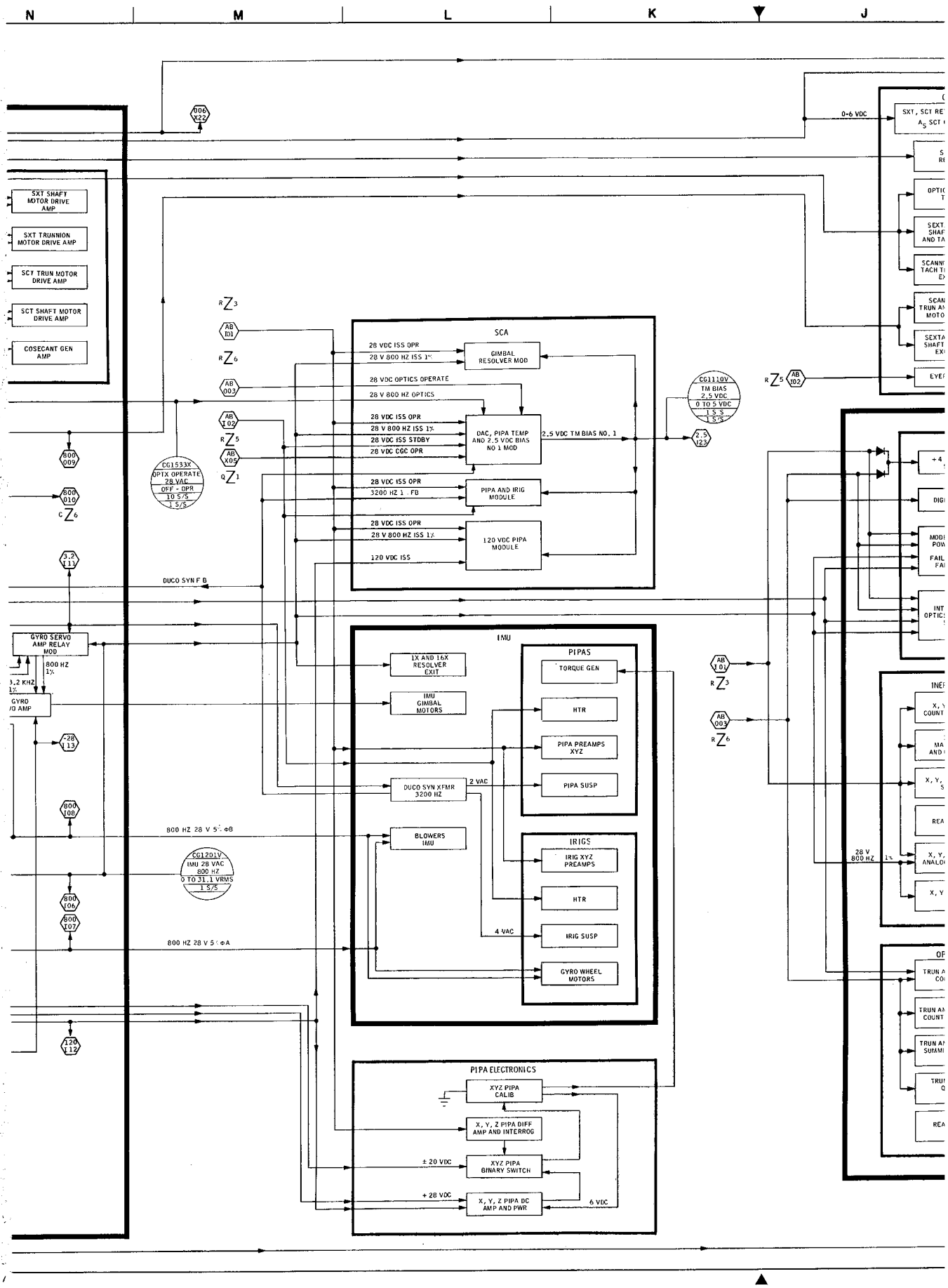
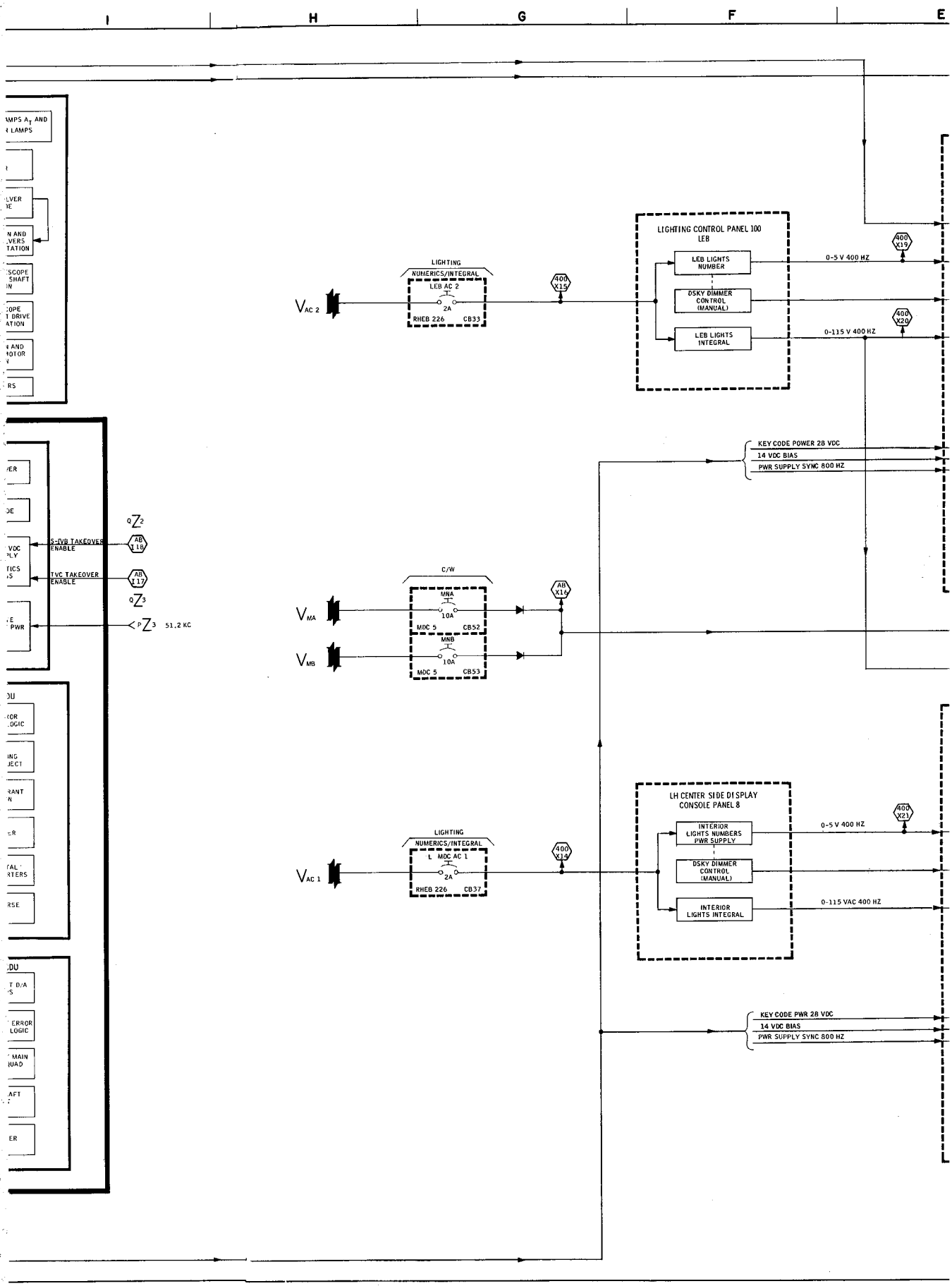
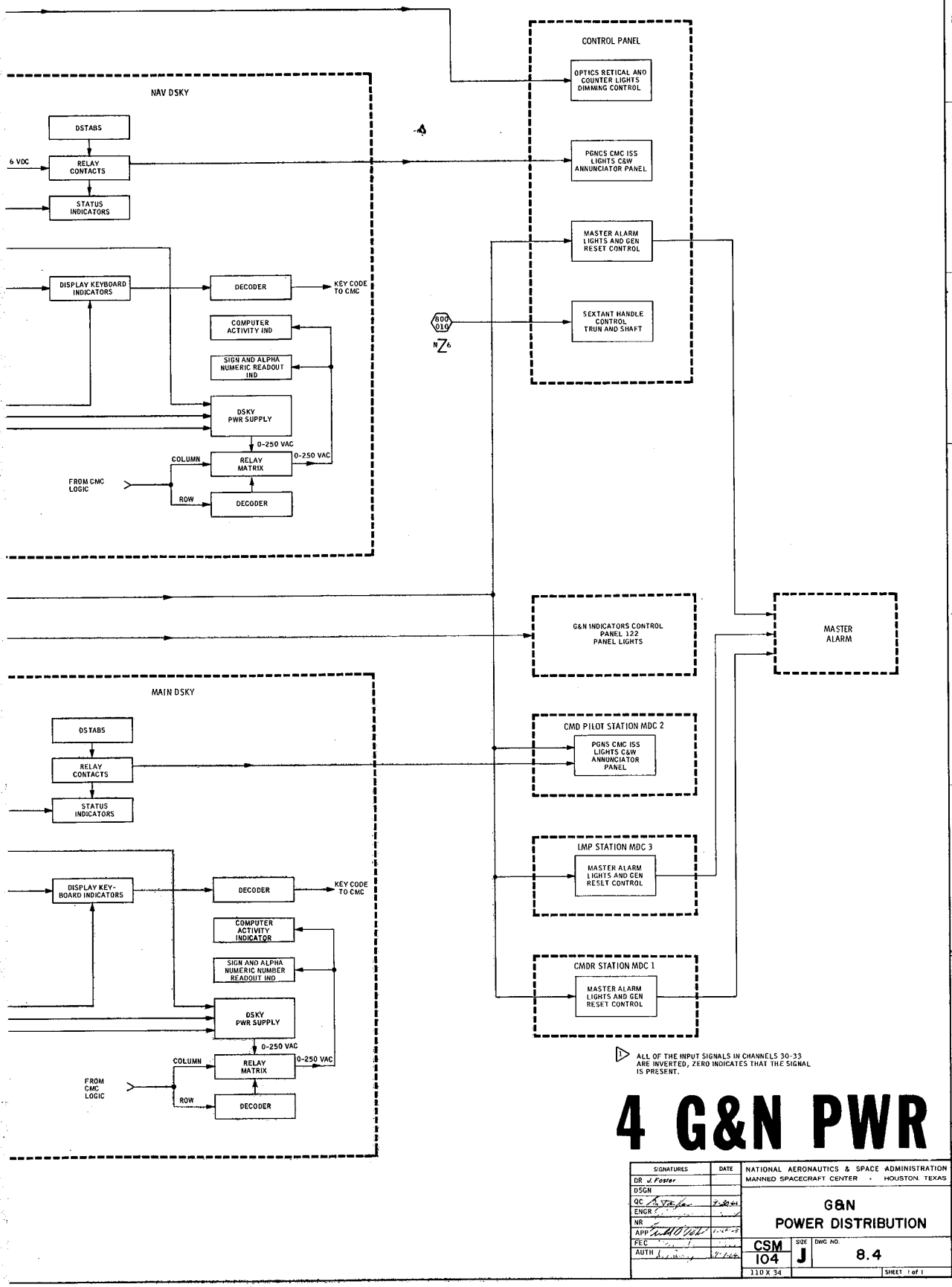
WORD NO.	DESCRIPTION	REAL-TIME SIGNIFICANCE		
97B	FAILREG	CONTAINS ALARM CODE OF FIRST ALARM RECEIVED		
98A	FAILREG+1	CONTAINS ALARM CODE OF SECOND ALARM RECEIVED		
98B	FAILREG+2	CONTAINS ALARM CODE OF THIRD ALARM RECEIVED		
99A	FLAGWORD 10	BIT	SET	RESET
		15	NOT USED	
	INTFLBIT	14	INTEGRATION IN PROGRESS	INTEGRATION NOT IN PROGRESS
		13	NOT USED	
		12	NOT USED	
		11	NOT USED	
		10	NOT USED	
		9	NOT USED	
		8	NOT USED	
	REINTFLG, REINTBIT	7	INTEGRATION ROUTINE TO BE RESTARTED	INTEGRATION ROUTINE NOT TO BE RESTARTED
		6	NOT USED	
		5	NOT USED	
		4	NOT USED	
		3	NOT USED	
		2	NOT USED	
		1	NOT USED	
99B	FLAGWORD 11	NOT USED		
100A	GAMMAEI	VALUE OF FLIGHT PATH ANGLE AT 400,000 FEET ABOVE FISCHER RADIUS		
100B	RTGO	RANGE ANGLE TO SPLASH FROM EMS INTERFACE ALTITUDE		


T
S
R
Q
P
O
8
7
6
5
4
3
2
1
GUIDANCE/NAVIGATION
POWER
AC 1
AC 2
2A
MDC 5
CB54
CB55
G N PWR
OFF
S12
OPTICS
MNA
MNB
10A
CB62
CB63
S1
IMU HTR
7.5A
CB58
CB59
IMU
25A
CB56
CB57
S2
IMU CAGE
MDC 1
S49
SC CONT
CMC
SC5
S18
TC-CW
TRANSLATION CONTROLLER
LV GUIDANCE
CMC
S69
28 VDC FROM S-IVB
TO S-IVB IU
CG1523X
CMC OPERATE -28 VDC
OFF - OPR
10 S.S.
11 S.S.
(V37E 06E) STBY (PROCEED BUTTON) OPR
CMC
CMC CLOCK AND SCALER
OPR PWR SUPPLY
+4 VDC -14 VDC
STBY PWR SUPPLY
+ 4 VDC + 14 VDC + 28 VDC
28 VDC KEY CODE PWR
14 VDC BIAS
3200 PPS 0° SET
3200 PPS 180° RESET
800 PPS 0° SET
800 PPS 180° RESET
12.8 KPPS 0° SET
12.8 KPPS 180° RESET
25.6 KPPS 0° SET
25.6 KPPS 180° RESET
800 PPS 0° SET
800 PPS 180° RESET
TO ECDU PWR SUPPLY
BLOCK UPLINK
HOLD
FREE
COMMUNICATIONS SUBSYSTEM PCM
UP TELEMETRY
ACCEPT
BLOCK
LEB 122
S10
UP TLM
S21
CMC MODE
AUTO
FREE
S35
PSA
RECTICLE ILLUM PWR SUPPLY
OPTICS RELAY
OPTICS AUTO OPERATE RELAY
SCAN TELESCOPE MODING RELAY
2 SPEED SWITCH
OPTICS POWER
800 HZ 28 V 5° -90° Φ PWR SUPPLY
800 HZ 28 V 1° -0° Φ AMP
800 HZ AAC VOLT V AND FILTER
3200 HZ PWR SUPPLY
PHASE AND AMPLITUDE CONTROL
1 AMPLIFIER
IMU AUX
GIMBAL SERVO OUT OF LIMIT
IMU TURN ON
IMU PWR
800 HZ 28 V 5% IMU Φ AMP
800 HZ 28 V 1% -0° Φ IMU AMP
800 HZ AAC IMU MULTIV AND FILTER
800 HZ 28 V 5% -90° Φ IMU AND AMP
PULSE TORQUE POWER SUPPLY
-28 VDC POWER SUPPLY
GYRO CALIBRATION
RELAYS AND DRIVER
BINARY SWITCH
DC DIFF AMP AND PWR

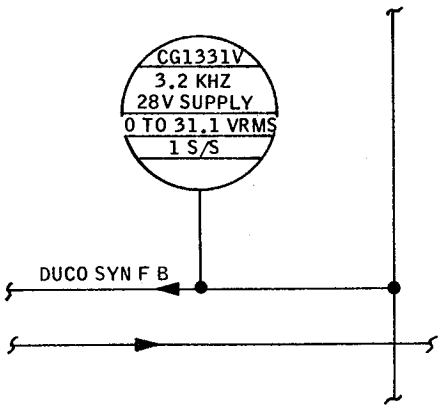

N
M
L
K
J
SXT SHAFT MOTOR DRIVE AMP
SXT TRUNNION MOTOR DRIVE AMP
SCT TRUN MOTOR DRIVE AMP
SCT SHAFT MOTOR DRIVE AMP
COSECANT GEN AMP
SCA
28 VDC ISS OPR
28 V 800 HZ ISS 1%
GIMBAL RESOLVER MOD
28 VDC OPTICS OPERATE
28 V 800 HZ OPTICS
28 VDC ISS OPR
28 V 800 HZ ISS 1%
28 VDC ISS STDBY
28 VDC CDU OPR
OAC, PIPA TEMP AND 2.5 VDC BIAS NO 1 MOD
2.5 VDC TM BIAS NO. 1
28 VDC ISS OPR
3200 HZ 1 FB
PIPA AND IRIG MODULE
28 VDC ISS OPR
28 V 800 HZ ISS 1%
120 VDC PIPA MODULE
120 VDC ISS
CG1110V
TM BIAS
2.5 VDC
0 TO 5 VDC
1 S/S
CG1533X
OPTX OPERATE
28 VAC
OFF - OPR
10 S/S
1 S/S
DUCO SYN F B
GYRO SERVO AMP RELAY MOD
800 HZ 1%
3.2 KHZ 1%
GYRO /O AMP
IMU
1X AND 16X RESOLVER EXIT
IMU GIMBAL MOTORS
DUCO SYN XFMR 3200 HZ
2 VAC
BLOWERS IMU
PIPAS
TORQUE GEN
HTR
PIPA PREAMPS XYZ
PIPA SUSP
IRIGS
IRIG XYZ PREAMPS
HTR
4 VAC
IRIG SUSP
GYRO WHEEL MOTORS
800 HZ 28 V 5° ΦB
800 HZ 28 V 5° ΦA
CG1201V
IMU 28 VAC
800 HZ
0 TO 31.1 VRMS
1 S/S
PIPA ELECTRONICS
XYZ PIPA CALIB
X, Y, Z PIPA DIFF AMP AND INTERROG
± 20 VDC
XYZ PIPA BINARY SWITCH
+ 28 VDC
X, Y, Z PIPA DC AMP AND PWR
6 VDC
0-6 VDC
28 V 800 HZ 1%


I
H
G
F
E
LIGHTING CONTROL PANEL 100
LEB
LEB LIGHTS NUMBER
DSKY DIMMER CONTROL (MANUAL)
LEB LIGHTS INTEGRAL
0-5 V 400 HZ
0-115 V 400 HZ
400 X19
400 X20
LIGHTING
NUMERICS/INTEGRAL
LEB AC 2
2A
RHEB 226
CB33
400 X15
$V_{AC\ 2}$
KEY CODE POWER 28 VDC
14 VDC BIAS
PWR SUPPLY SYNC 800 HZ
C/W
MNA
10A
MDC 5
CB52
MNB
10A
MDC 5
CB53
AB X16
V_{MA}
V_{MB}
LH CENTER SIDE DISPLAY
CONSOLE PANEL 8
INTERIOR LIGHTS NUMBERS PWR SUPPLY
DSKY DIMMER CONTROL (MANUAL)
INTERIOR LIGHTS INTEGRAL
0-5 V 400 HZ
0-115 VAC 400 HZ
400 X21
LIGHTING
NUMERICS/INTEGRAL
L MDC AC 1
2A
RHEB 226
CB37
400 X14
$V_{AC\ 1}$
KEY CODE PWR 28 VDC
14 VDC BIAS
PWR SUPPLY SYNC 800 HZ
AB I16
AB I17
51.2 KC

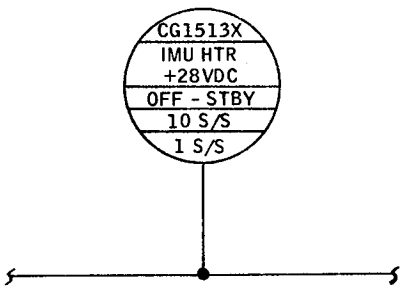

D
C
B
A
LTR
DR
ENGR
DATE
APPROVAL
8
7
6
5
4
3
2
1
CONTROL PANEL
OPTICS RETICAL AND COUNTER LIGHTS DIMMING CONTROL
PGNCS CMC ISS LIGHTS C&W ANNUNCIATOR PANEL
MASTER ALARM LIGHTS AND GEN RESET CONTROL
SEXTANT HANDLE CONTROL TRUN AND SHAFT
600 010
NAV DSKY
DSTABS
6 VDC
RELAY CONTACTS
STATUS INDICATORS
DISPLAY KEYBOARD INDICATORS
DECODER
KEY CODE TO CMC
COMPUTER ACTIVITY IND
SIGN AND ALPHA NUMERIC READOUT IND
DSKY PWR SUPPLY
0-250 VAC
COLUMN
RELAY MATRIX
0-250 VAC
FROM CMC LOGIC
ROW
DECODER
G&N INDICATORS CONTROL PANEL 122 PANEL LIGHTS
MASTER ALARM
MAIN DSKY
DSTABS
RELAY CONTACTS
STATUS INDICATORS
DISPLAY KEY-BOARD INDICATORS
DECODER
KEY CODE TO CMC
COMPUTER ACTIVITY INDICATOR
SIGN AND ALPHA NUMERIC NUMBER READOUT IND
DSKY PWR SUPPLY
0-250 VAC
COLUMN
RELAY MATRIX
0-250 VAC
FROM CMC LOGIC
ROW
DECODER
CMD PILOT STATION MDC 2
PGNS CMC ISS LIGHTS C&W ANNUNCIATOR PANEL
LMP STATION MDC 3
MASTER ALARM LIGHTS AND GEN RESET CONTROL
CMDR STATION MDC 1
MASTER ALARM LIGHTS AND GEN RESET CONTROL
1 ALL OF THE INPUT SIGNALS IN CHANNELS 30-33 ARE INVERTED, ZERO INDICATES THAT THE SIGNAL IS PRESENT.
4 G&N PWR
SIGNATURES
DATE
DR J. Foster
DSGN
QC
ENGR
NR
APP
FEC
AUTH
NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS
G&N POWER DISTRIBUTION
CSM 104
SIZE J
DWG NO. 8.4
110 X 34
SHEET 1 of 1

IS

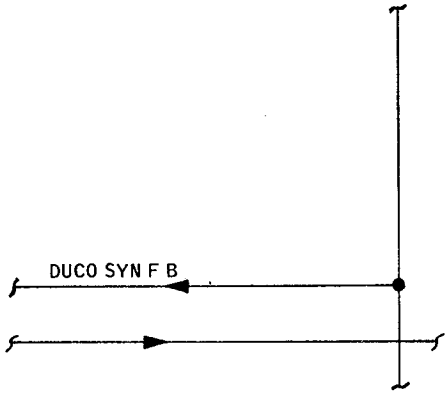
1. DWG 8.4 M Z 5

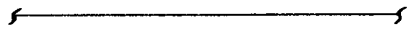


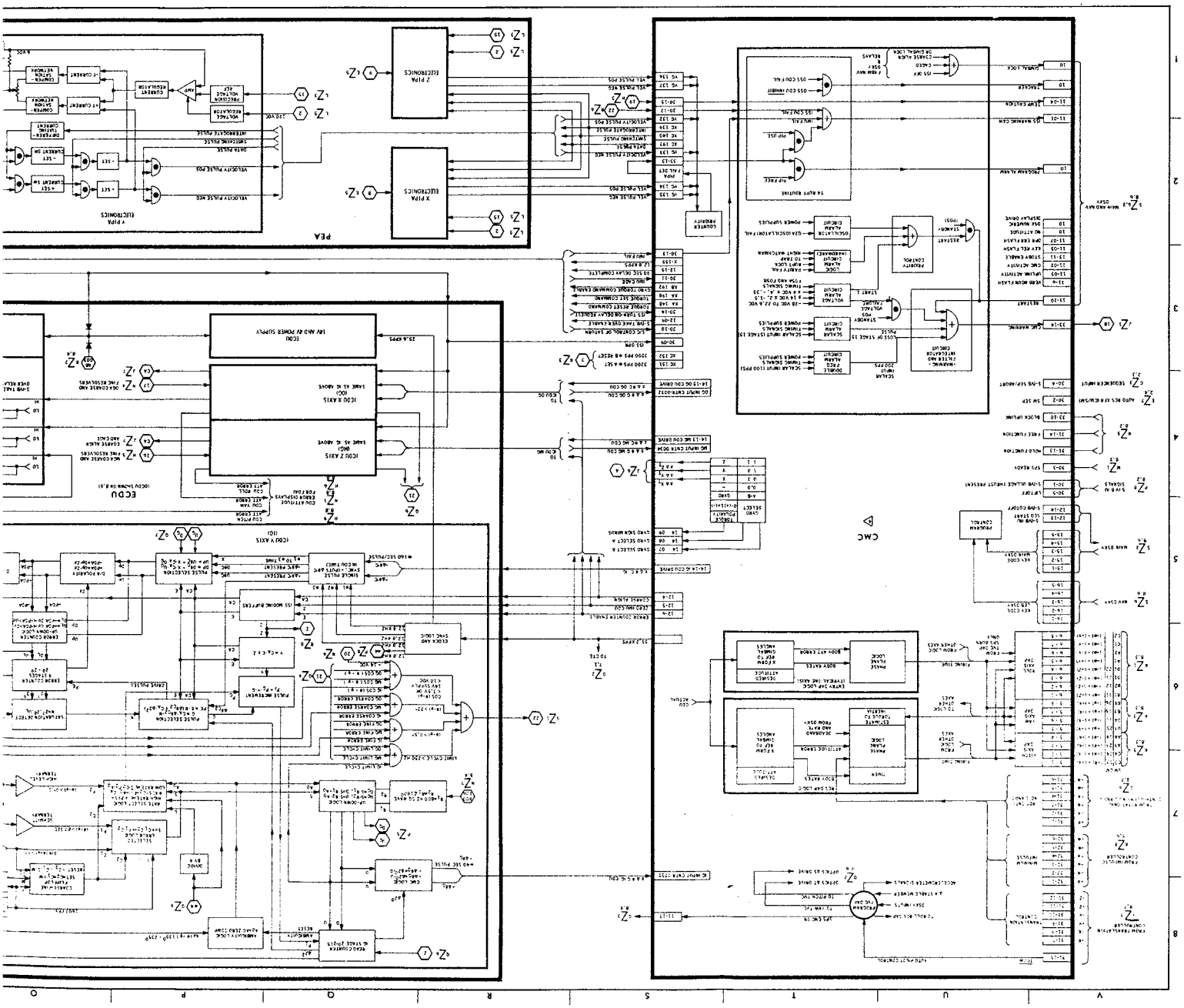
2. DWG 8.4 R Z 5

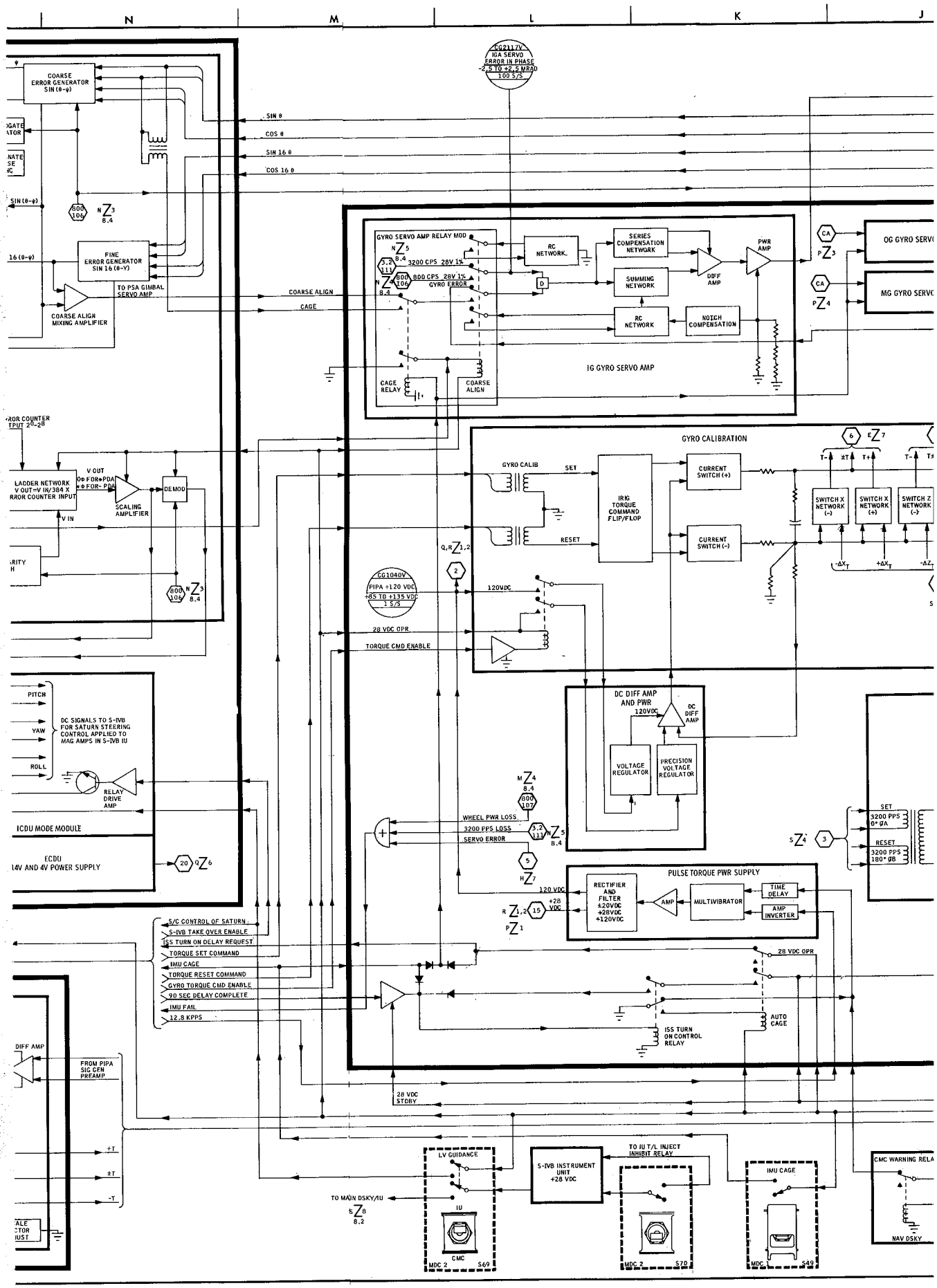


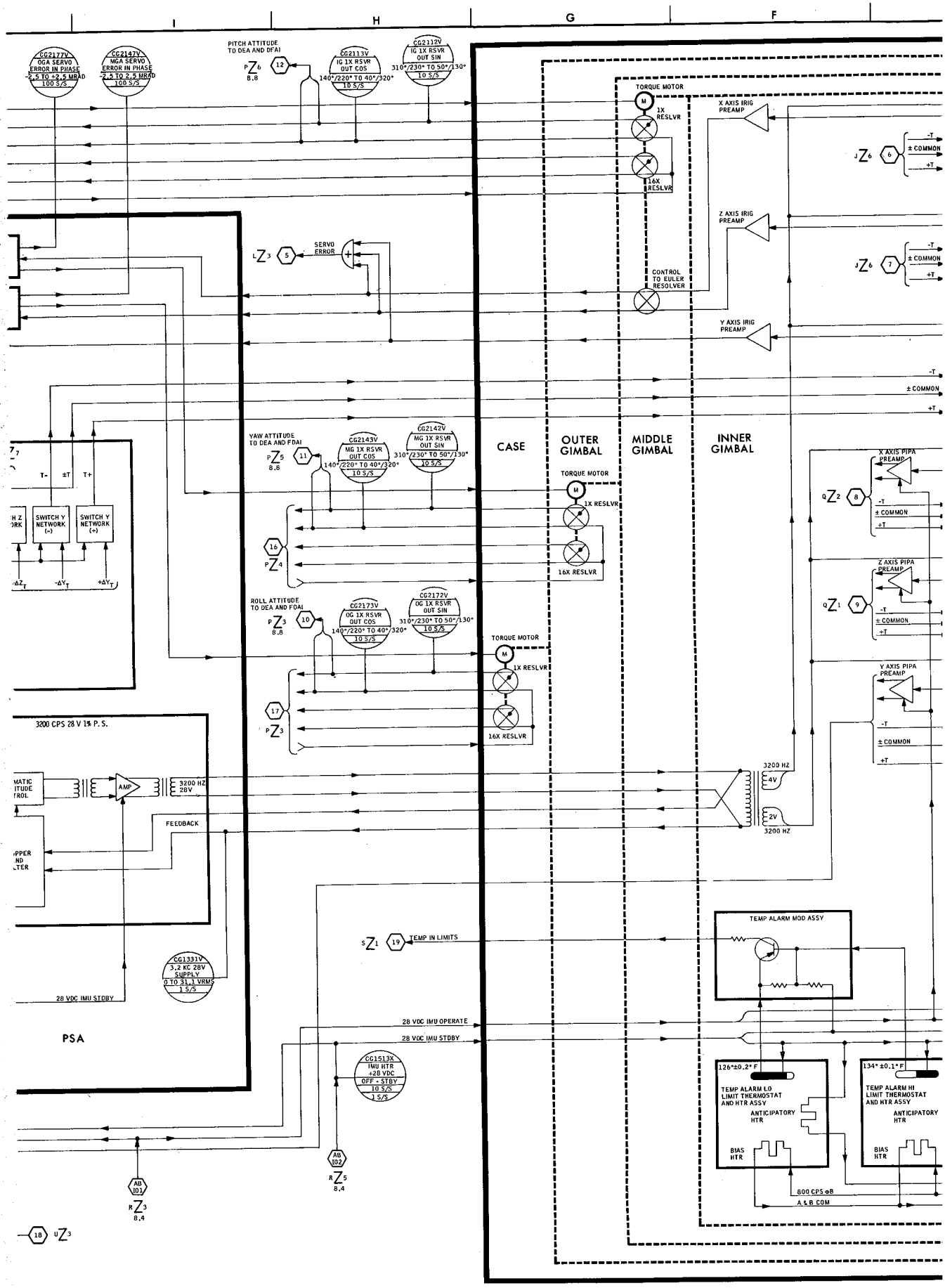
WAS

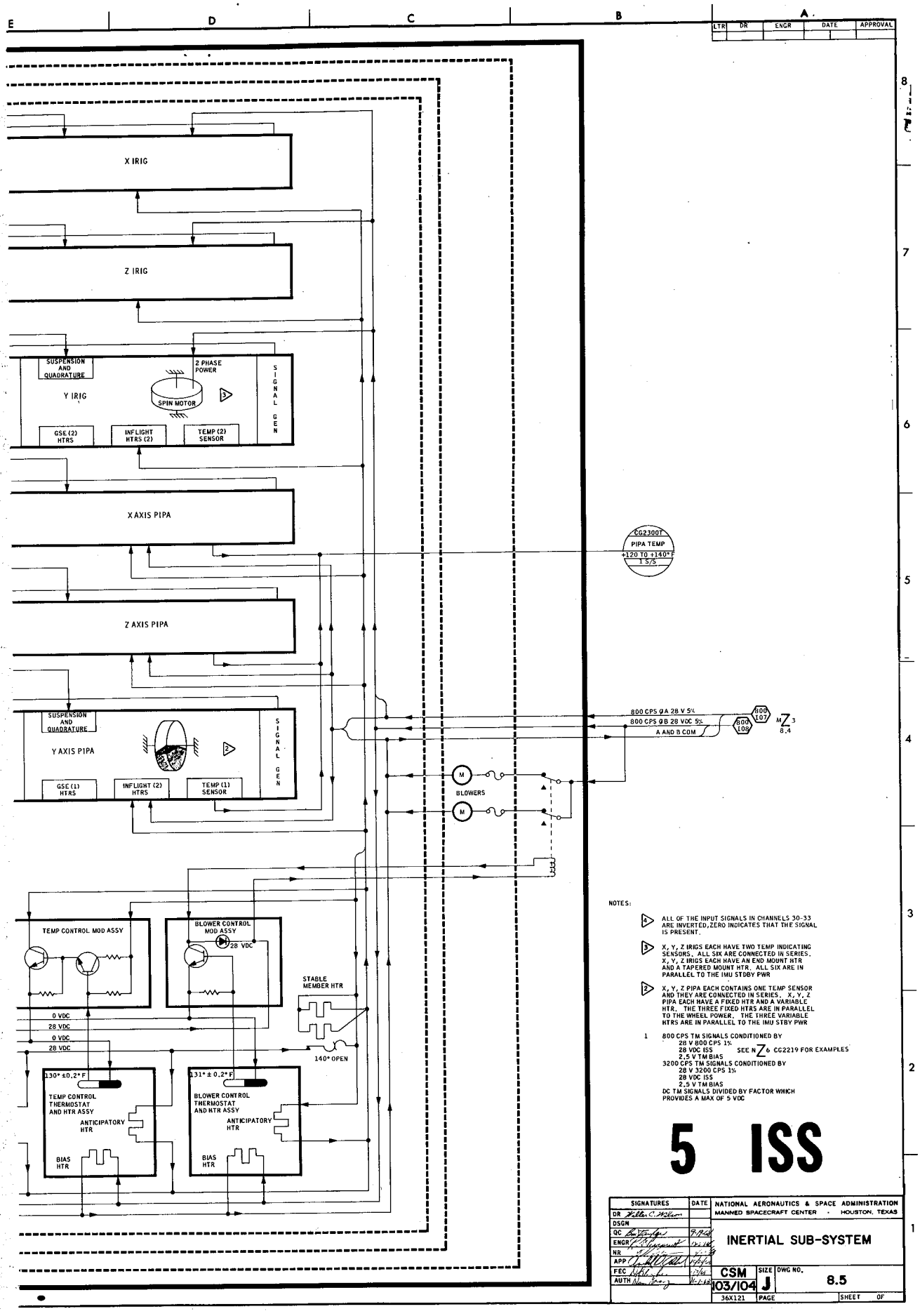







N
M
L
K
J
CG2117V
IGA SERVO ERROR IN PHASE
-2.5 TO +2.5 MRAD
100 S/S
COARSE ERROR GENERATOR SIN (θ-ψ)
SIN θ
COS θ
SIN 16 θ
COS 16 θ
SIN (θ-ψ)
FINE ERROR GENERATOR SIN 16 (θ-Y)
TO PSA GIMBAL SERVO AMP
COARSE ALIGN MIXING AMPLIFIER
COARSE ALIGN
CAGE
GYRO SERVO AMP RELAY MOD
3200 CPS 28V 1%
800 CPS 28V 1%
GYRO ERROR
RC NETWORK
SERIES COMPENSATION NETWORK
SUMMING NETWORK
DIFF AMP
PWR AMP
RC NETWORK
NOTCH COMPENSATION
IG GYRO SERVO AMP
CAGE RELAY
COARSE ALIGN
OG GYRO SERVO
MG GYRO SERVO
GYRO CALIBRATION
GYRO CALIB
SET
RESET
IRIG TORQUE COMMAND FLIP/FLOP
CURRENT SWITCH (+)
CURRENT SWITCH (-)
SWITCH X NETWORK (-)
SWITCH X NETWORK (+)
SWITCH Z NETWORK (-)
CG1040V
PIPA +120 VDC
+85 TO +135 VDC
1 S/S
120VDC
28 VDC OPR
TORQUE CMD ENABLE
LADDER NETWORK
V OUT=V IN/384 X ERROR COUNTER INPUT
V OUT
0Ø FOR+PDA
±Ø FOR-PDA
SCALING AMPLIFIER
DEMOD
V IN
PITCH
YAW
ROLL
DC SIGNALS TO S-IVB FOR SATURN STEERING CONTROL APPLIED TO MAG AMPS IN S-IVB IU
RELAY DRIVE AMP
ICDU MODE MODULE
ECDU
L4V AND 4V POWER SUPPLY
DC DIFF AMP AND PWR
120VDC
DC DIFF AMP
VOLTAGE REGULATOR
PRECISION VOLTAGE REGULATOR
WHEEL PWR LOSS
3200 PPS LOSS
SERVO ERROR
PULSE TORQUE PWR SUPPLY
RECTIFIER AND FILTER ±20VDC +28VDC +120VDC
AMP
MULTIVIBRATOR
TIME DELAY
AMP INVERTER
120 VDC
+28 VDC
SET
3200 PPS 0° ØA
RESET
3200 PPS 180° ØB
S/C CONTROL OF SATURN
S-IVB TAKE OVER ENABLE
ISS TURN ON DELAY REQUEST
TORQUE SET COMMAND
IMU CAGE
TORQUE RESET COMMAND
GYRO TORQUE CMD ENABLE
90 SEC DELAY COMPLETE
IMU FAIL
12.8 KPPS
28 VDC OPR
AUTO CAGE
ISS TURN ON CONTROL RELAY
28 VDC STDBY
DIFF AMP
FROM PIPA SIG GEN PREAMP
+T
±T
-T
LV GUIDANCE
IU
CMC
MDC 2
S69
TO MAIN DSKY/IU
S-IVB INSTRUMENT UNIT +28 VDC
TO IU T/L INJECT INHIBIT RELAY
MDC 2
S7D
IMU CAGE
MDC
S49
CMC WARNING RELA
NAV DSKY


I
H
G
F
CG2177V
OGA SERVO ERROR IN PHASE
-2.5 TO +2.5 MRAD
100 S/S
CG2147V
MGA SERVO ERROR IN PHASE
-2.5 TO 2.5 MRAD
100 S/S
PITCH ATTITUDE TO DEA AND DFAI
P Z 6
8.8
12
CG2113V
IG 1X RSVR OUT COS
140°/220° TO 40°/320°
10 S/S
CG2112V
IG 1X RSVR OUT SIN
310°/230° TO 50°/130°
10 S/S
TORQUE MOTOR
1X RESLVR
16X RESLVR
X AXIS IRIG PREAMP
Z AXIS IRIG PREAMP
Y AXIS IRIG PREAMP
CONTROL TO EULER RESOLVER
J Z 6
6
7
-T
± COMMON
+T
L Z 3
5
SERVO ERROR
CASE
OUTER GIMBAL
MIDDLE GIMBAL
INNER GIMBAL
YAW ATTITUDE TO DEA AND FDAI
P Z 5
8.8
11
CG2143V
MG 1X RSVR OUT COS
140°/220° TO 40°/320°
10 S/S
CG2142V
MG 1X RSVR OUT SIN
310°/230° TO 50°/130°
10 S/S
16
P Z 4
ROLL ATTITUDE TO DEA AND FOAI
P Z 3
8.8
10
CG2173V
OG 1X RSVR OUT COS
140°/220° TO 40°/320°
10 S/S
CG2172V
OG 1X RSVR OUT SIN
310°/230° TO 50°/130°
10 S/S
17
P Z 3
Q Z 2
8
X AXIS PIPA PREAMP
Q Z 1
9
Z AXIS PIPA PREAMP
Y AXIS PIPA PREAMP
SWITCH Y NETWORK (-)
SWITCH Y NETWORK (+)
T-
±T
T+
-ΔZT
-ΔYT
+ΔYT
3200 CPS 28 V 1% P. S.
AMP
3200 HZ 28V
FEEDBACK
3200 HZ
4V
2V
3200 HZ
28 VDC IMU STDBY
CG1331V
3.2 KC 28V SUPPLY
0 TO 31.1 VRMS
1 S/S
PSA
S Z 1
19
TEMP IN LIMITS
TEMP ALARM MOD ASSY
28 VDC IMU OPERATE
28 VDC IMU STDBY
CG1513X
IMU HTR +28 VDC
OFF - STBY
10 S/S
1 S/S
126°±0.2°F
TEMP ALARM LO LIMIT THERMOSTAT AND HTR ASSY
ANTICIPATORY HTR
BIAS HTR
134°±0.1°F
TEMP ALARM HI LIMIT THERMOSTAT AND HTR ASSY
ANTICIPATORY HTR
BIAS HTR
800 CPS ØB
A & B COM
AB I01
R Z 3
8.4
AB I02
R Z 5
8.4
18
U Z 3



NOTES:

3 ALL OF THE INPUT SIGNALS IN CHANNELS 30-33 ARE INVERTED, ZERO INDICATES THAT THE SIGNAL IS PRESENT.

4 X, Y, Z IRIGS EACH HAVE TWO TEMP INDICATING SENSORS. ALL SIX ARE CONNECTED IN SERIES. X, Y, Z IRIGS EACH HAVE AN END MOUNT HTR AND A TAPERED MOUNT HTR. ALL SIX ARE IN PARALLEL TO THE IMU STDBY PWR

2 X, Y, Z PIPA EACH CONTAINS ONE TEMP SENSOR AND THEY ARE CONNECTED IN SERIES. X, Y, Z PIPA EACH HAVE A FIXED HTR AND A VARIABLE HTR. THE THREE FIXED HTRS ARE IN PARALLEL TO THE WHEEL POWER. THE THREE VARIABLE HTRS ARE IN PARALLEL TO THE IMU STBY PWR

1 800 CPS TM SIGNALS CONDITIONED BY
28 V 800 CPS 1%
28 VDC ISS SEE N Z 6 CG2219 FOR EXAMPLES
2.5 V TM BIAS
3200 CPS TM SIGNALS CONDITIONED BY
28 V 3200 CPS 1%
28 VDC ISS
2.5 V TM BIAS
DC TM SIGNALS DIVIDED BY FACTOR WHICH PROVIDES A MAX OF 5 VDC

5 ISS

SIGNATURES	DATE
DR	
DSGN	
QC	
ENGR	
NR	
APP	
FEC	
AUTH	

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS

INERTIAL SUB-SYSTEM

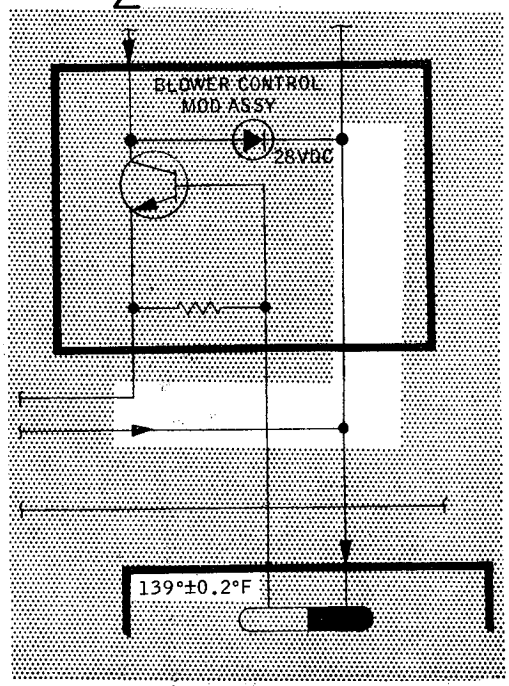
CSM 103/104 | SIZE J | DWG NO. 8.5

36X121 | PAGE | SHEET OF

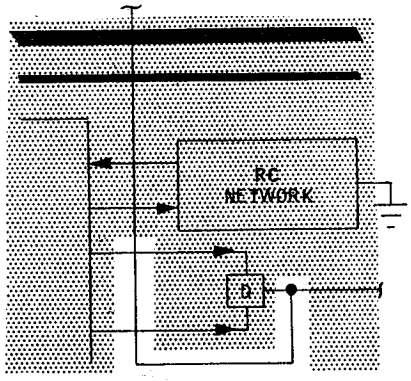
SECTION 8

IS

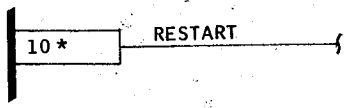
1. DWG 8.5 D Z 2



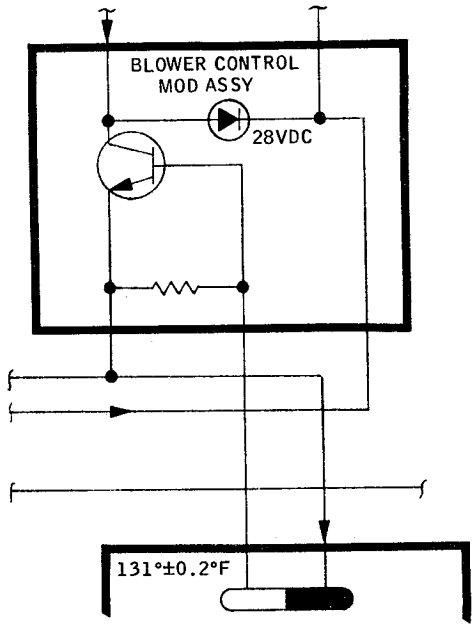
2. DWG 8.5 L Z 7

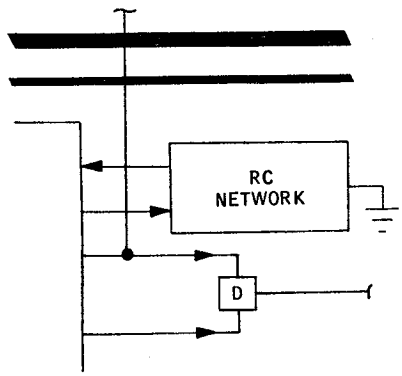


3. DWG 8.5 U Z 3



WAS

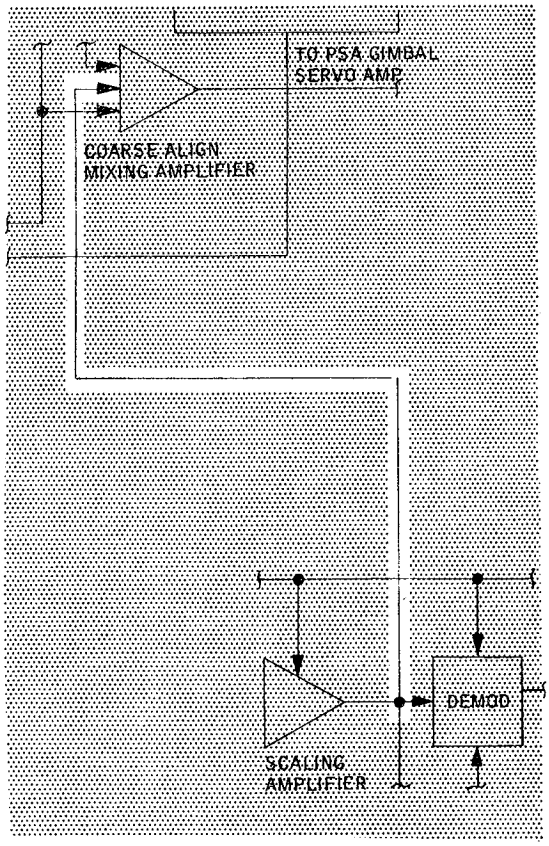




SECTION 8

IS

4. DWG 8.5 N Z 6



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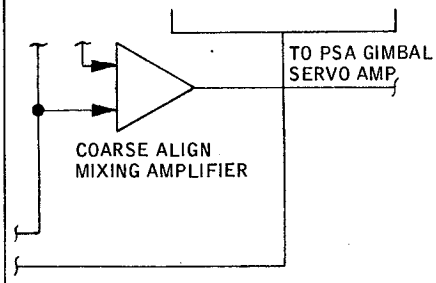
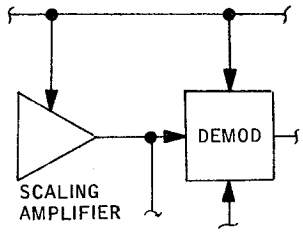
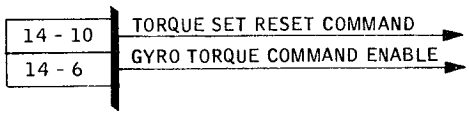
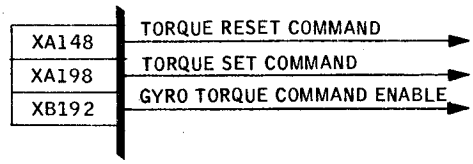




5. DWG 8.5 S Z 3

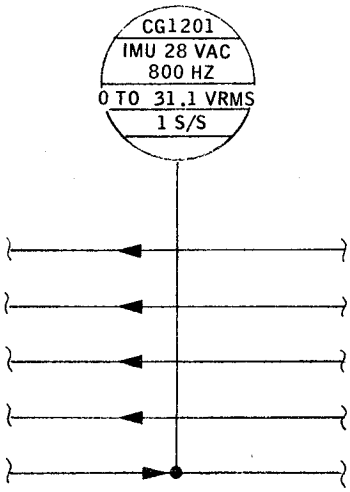




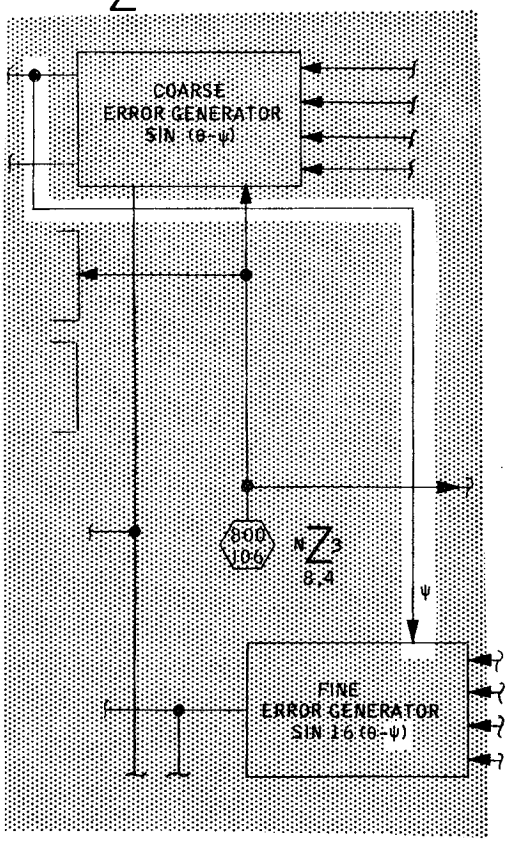
SECTION 8

IS

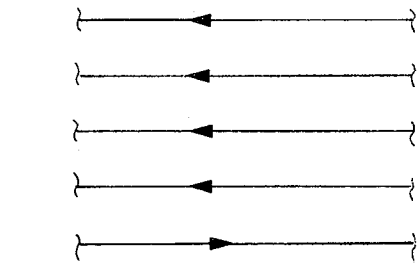
6. DWG 8.5 K Z 7

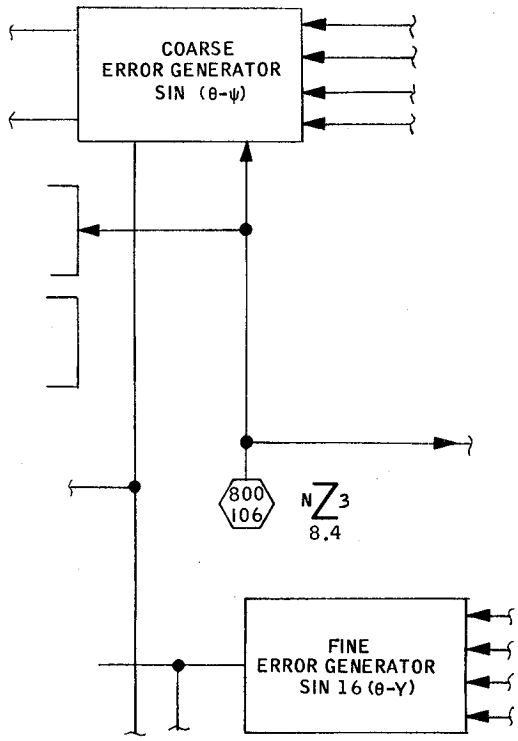


7. DWG 8.5 N Z 6

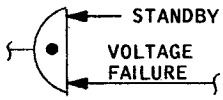
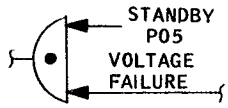


WAS





SECTION 8

IS	WAS
8. DWG 8.5 T Z 3	
TC TRAP	TO TRAP
9. DWG 8.5 T Z 3	
	
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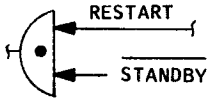	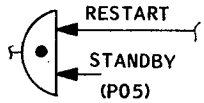
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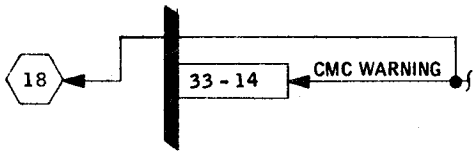
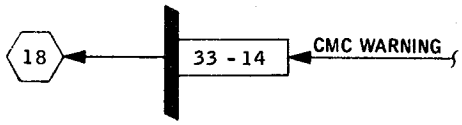
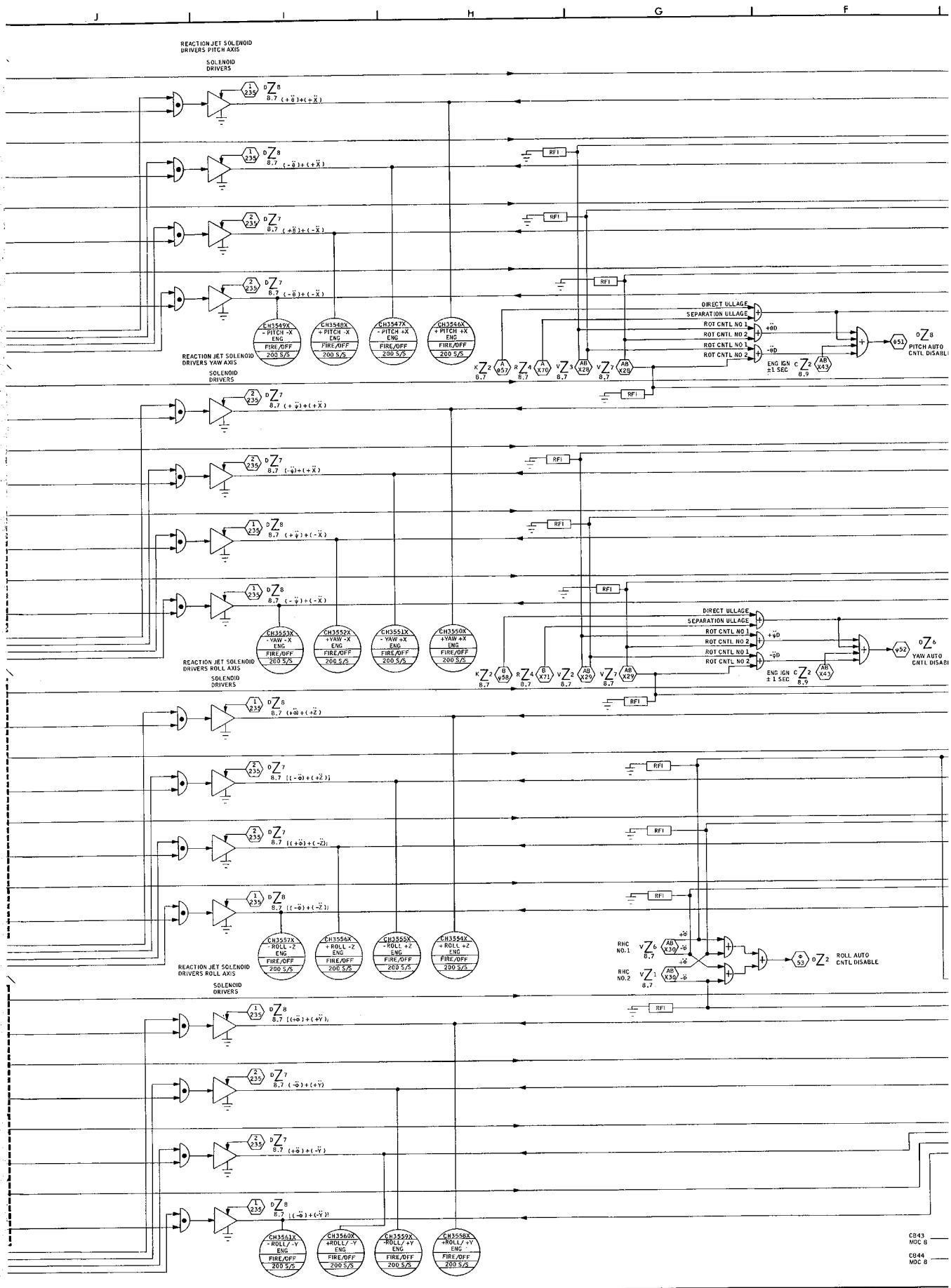
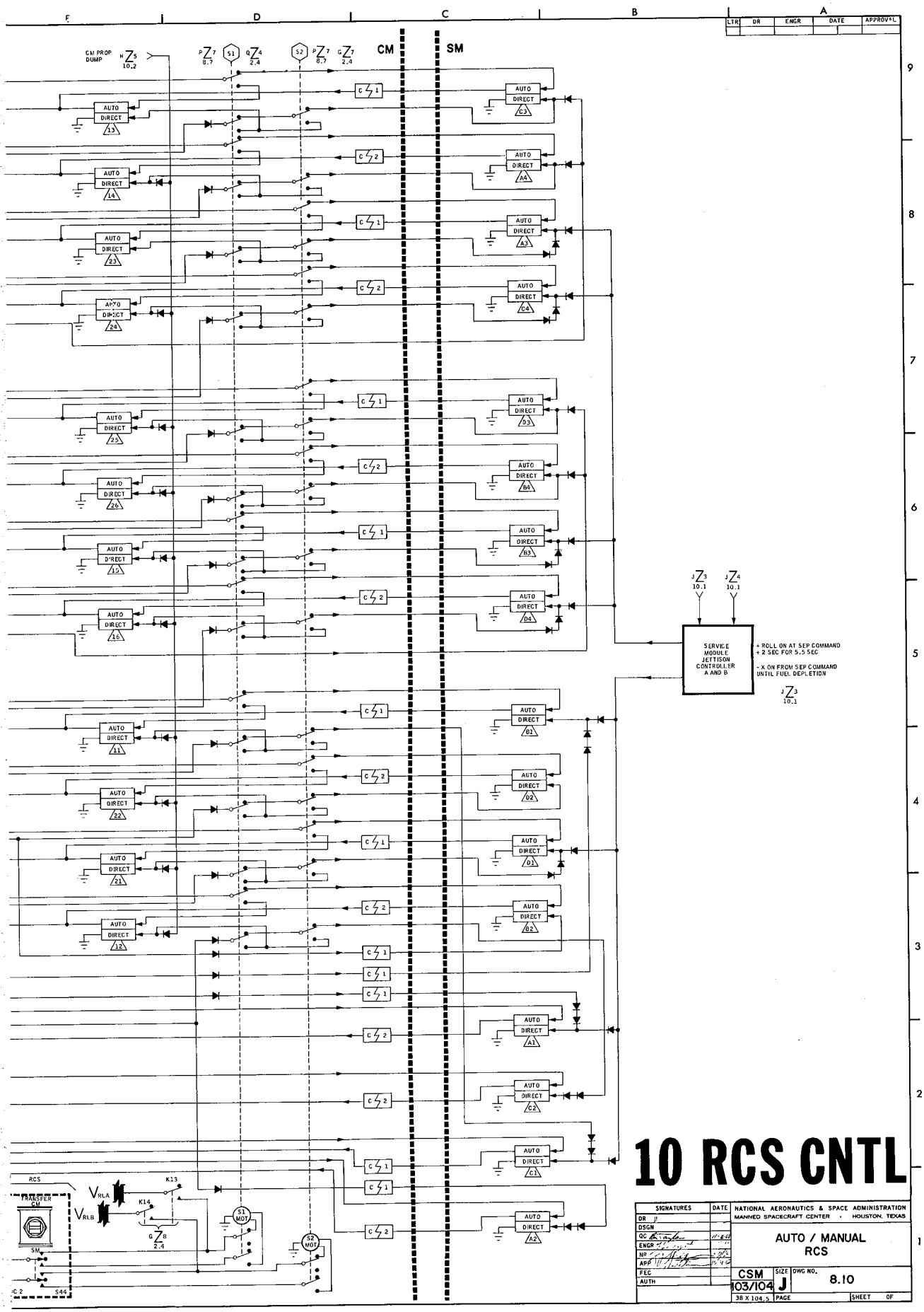
	


J
I
H
G
F
REACTION JET SOLENOID DRIVERS PITCH AXIS
SOLENOID DRIVERS
REACTION JET SOLENOID DRIVERS YAW AXIS
REACTION JET SOLENOID DRIVERS ROLL AXIS
CH3549X - PITCH -X ENG FIRE/OFF 200 S/S
CH3548X + PITCH -X ENG FIRE/OFF 200 S/S
CH3547X - PITCH +X ENG FIRE/OFF 200 S/S
CH3546X + PITCH +X ENG FIRE/OFF 200 S/S
CH3553X - YAW -X ENG FIRE/OFF 200 S/S
CH3552X + YAW -X ENG FIRE/OFF 200 S/S
CH3551X - YAW +X ENG FIRE/OFF 200 S/S
CH3550X + YAW +X ENG FIRE/OFF 200 S/S
CH3557X - ROLL -Z ENG FIRE/OFF 200 S/S
CH3556X + ROLL -Z ENG FIRE/OFF 200 S/S
CH3555X - ROLL +Z ENG FIRE/OFF 200 S/S
CH3554X + ROLL +Z ENG FIRE/OFF 200 S/S
CH3561X - ROLL/ -Y ENG FIRE/OFF 200 S/S
CH3560X + ROLL/ -Y ENG FIRE/OFF 200 S/S
CH3559X - ROLL/ +Y ENG FIRE/OFF 200 S/S
CH3558X + ROLL/ +Y ENG FIRE/OFF 200 S/S
RFI
DIRECT ULLAGE
SEPARATION ULLAGE
ROT CNTL NO 1
ROT CNTL NO 2
ROT CNTL NO 1
ROT CNTL NO 2
ENG IGN ±1 SEC
PITCH AUTO CNTL DISABLE
YAW AUTO CNTL DISABLE
RHC NO.1
RHC NO.2
ROLL AUTO CNTL DISABLE
CB43 MDC 8
CB44 MDC 8



10 RCS CNTL

LTR	DR	ENGR	DATE	APPROV'L

SIGNATURES	DATE
DR	
DSGN	
QC	
ENGR	
NR	
APP	
FEC	
AUTH	

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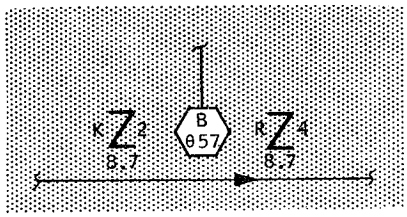
AUTO / MANUAL RCS

CSM	SIZE	DWG NO.
103/104	J	8.10

38 X 104.5 | PAGE | SHEET OF

IS

1. DWG 8.10 H Z 7



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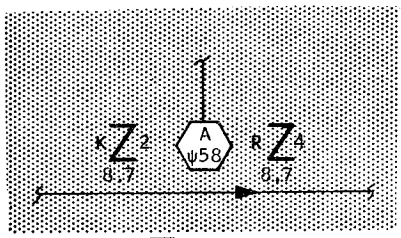

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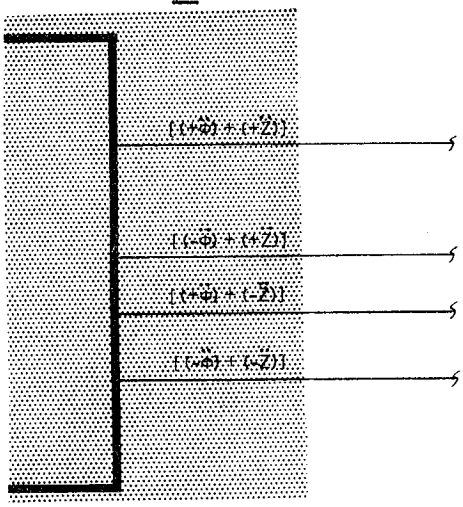
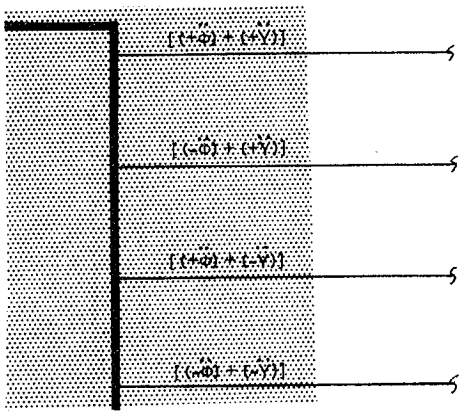


4. DWG 8.10 L Z 2,1



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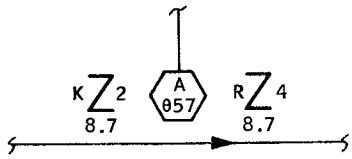
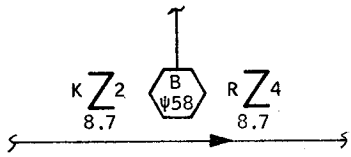
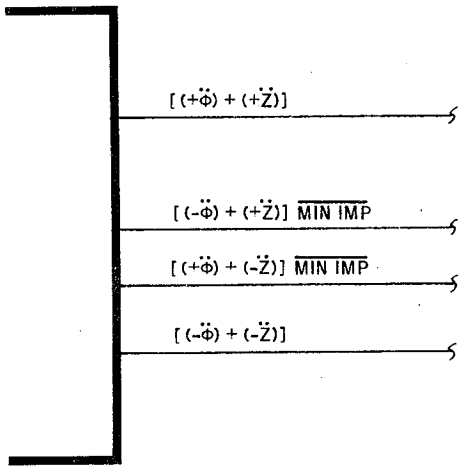
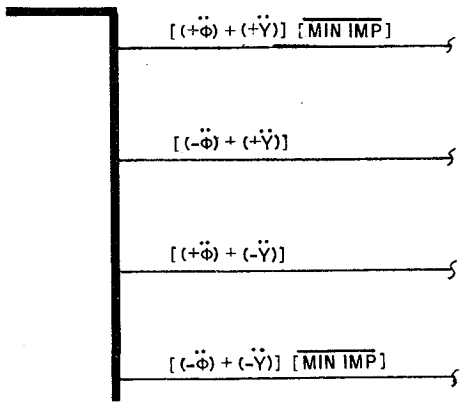
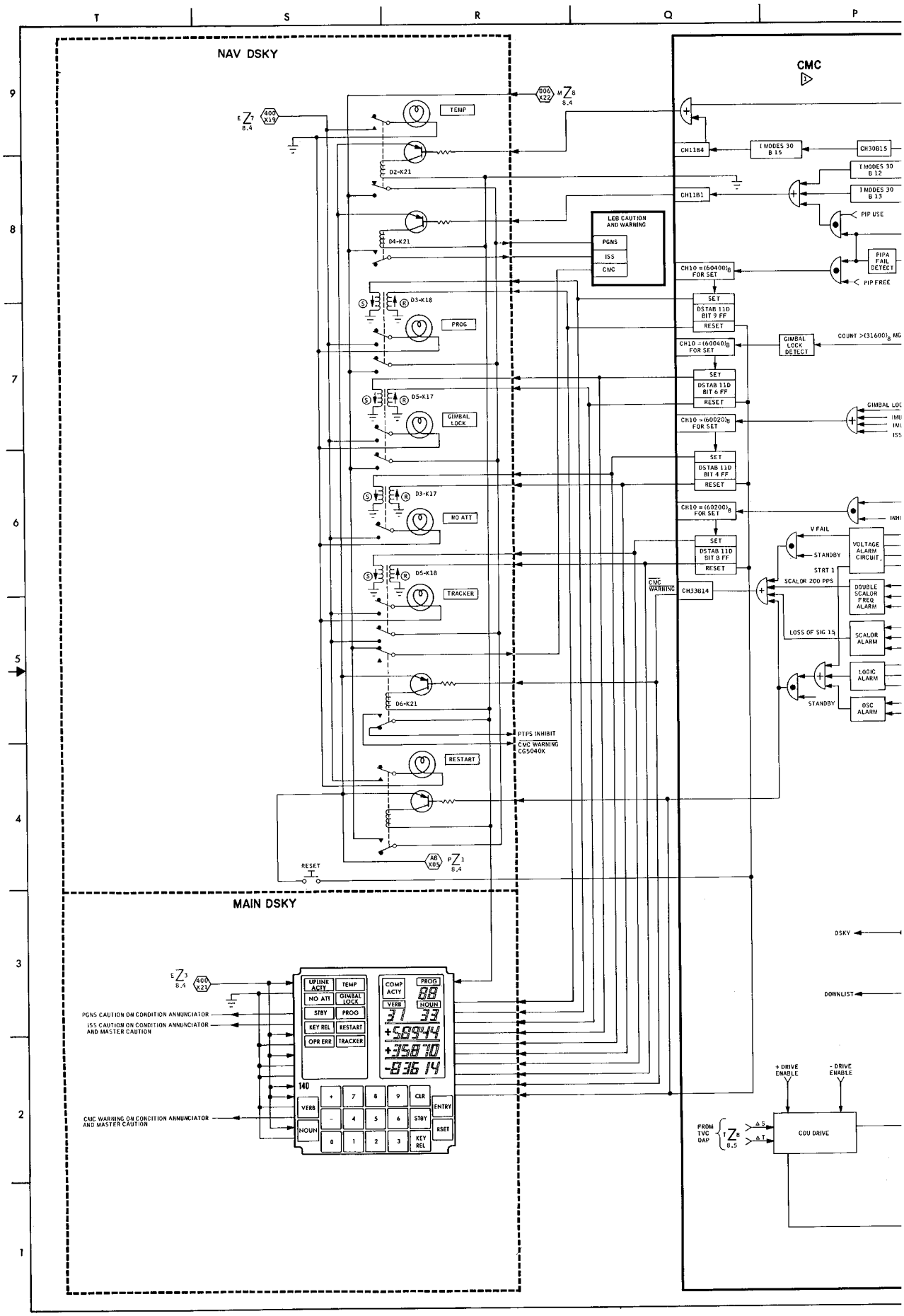


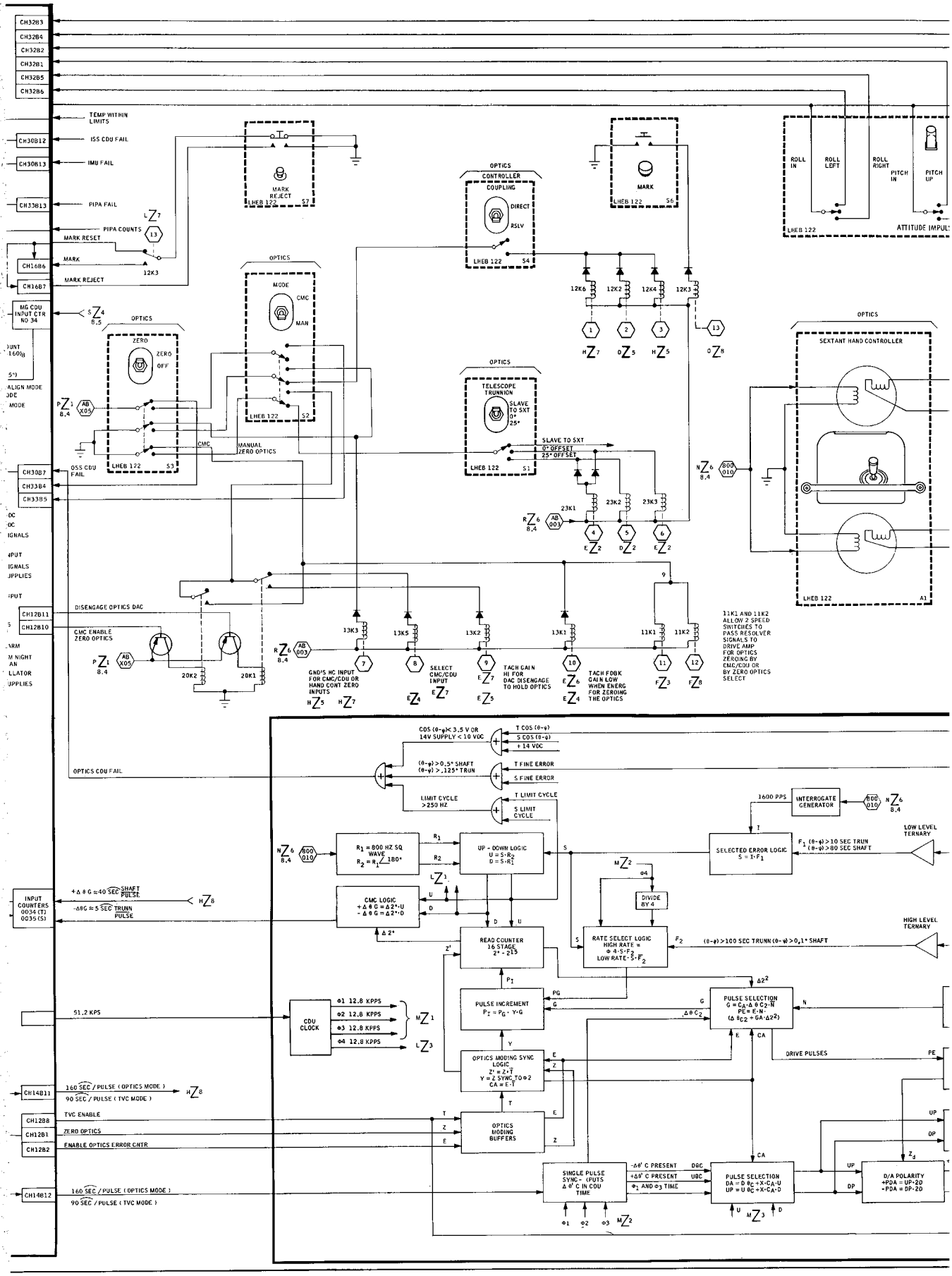


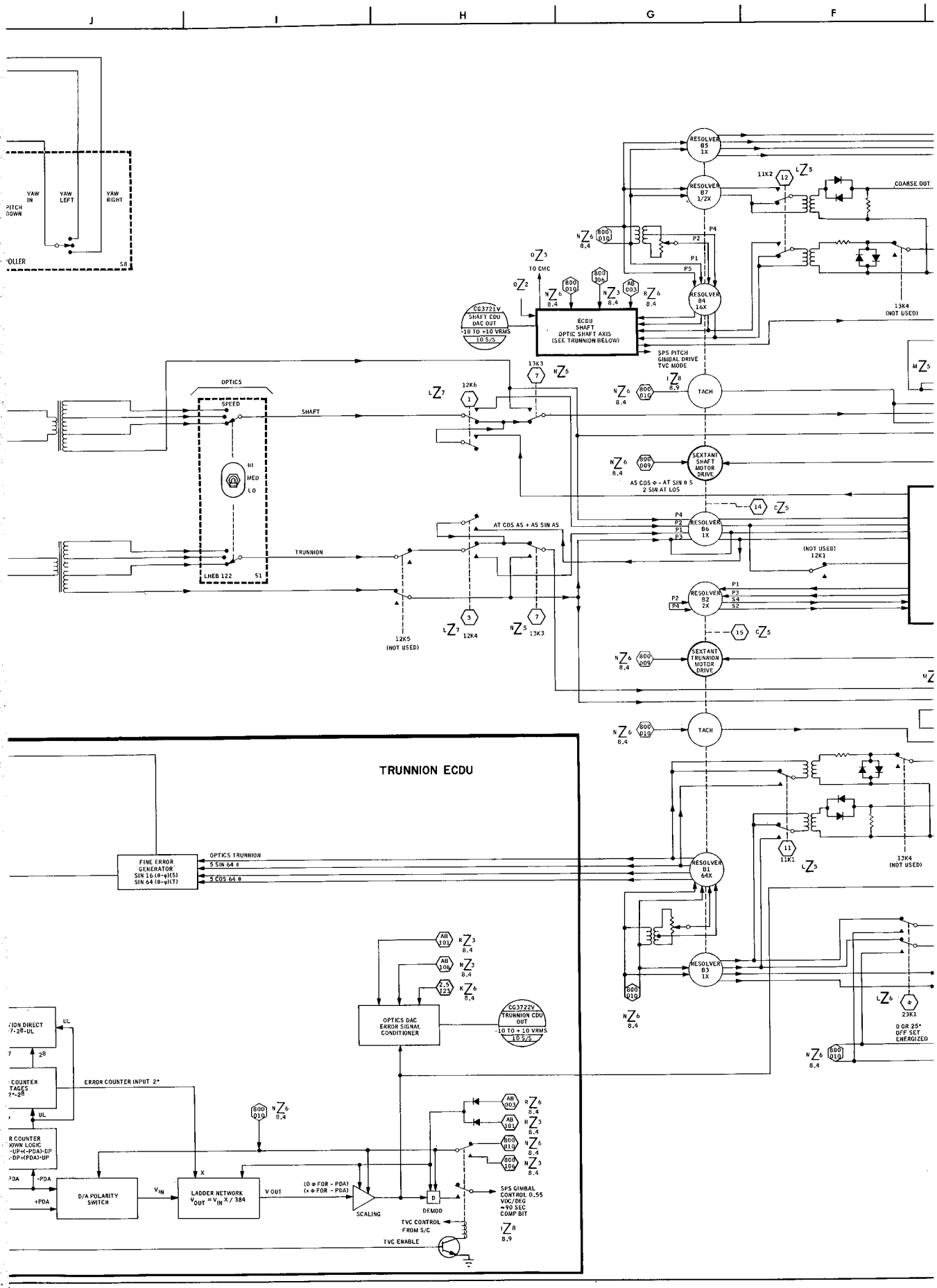


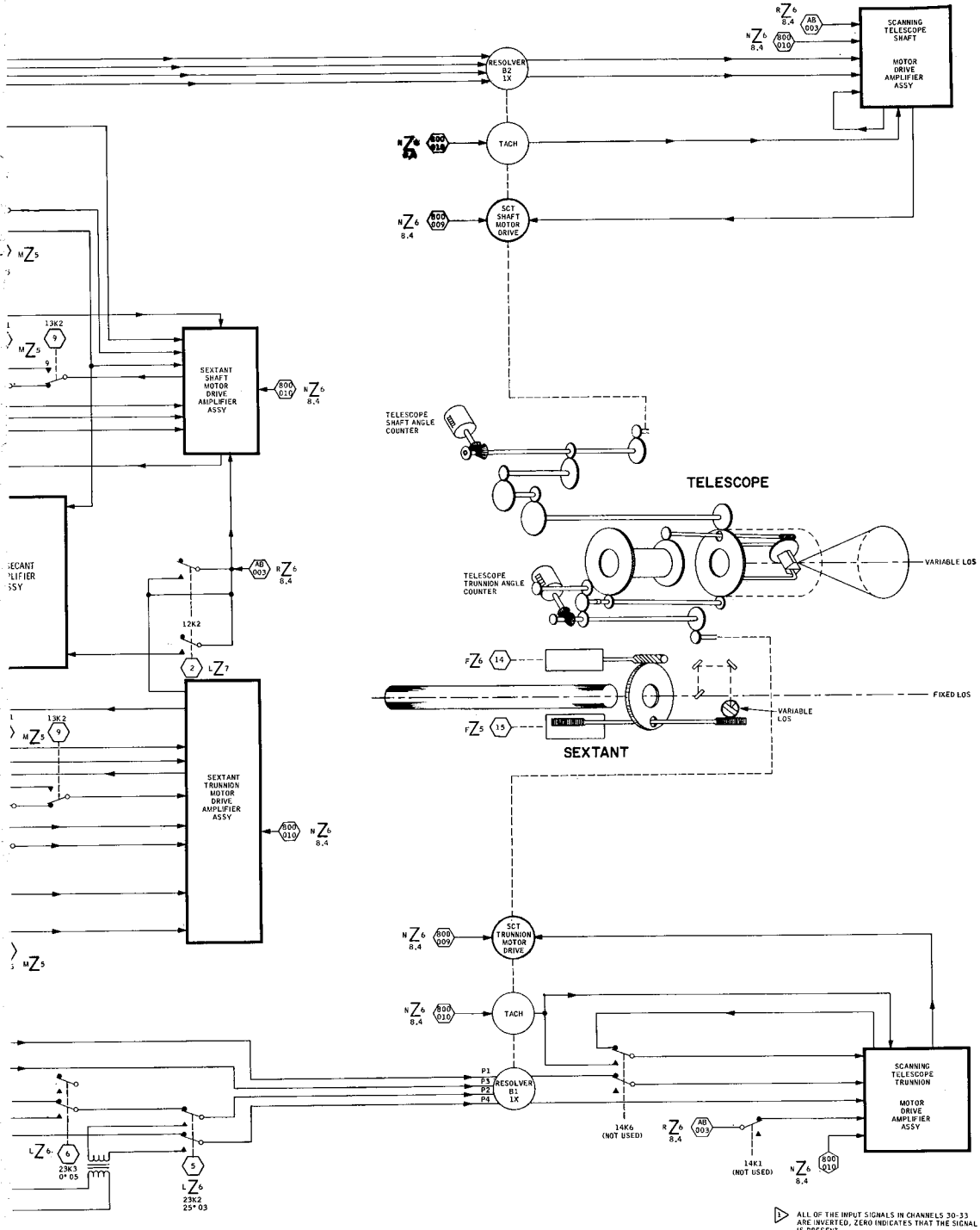


9 SERVICE PROPULSION SYSTEM


NAV DSKY
MAIN DSKY
CMC
TEMP
D2-K21
D4-K21
D3-K18
PROG
D5-K17
GIMBAL LOCK
D3-K17
NO ATT
D5-K18
TRACKER
D6-K21
RESTART
RESET
LEB CAUTION AND WARNING
PGNS
ISS
CMC
PTPS INHIBIT
CMC WARNING CG5040X
PGNS CAUTION ON CONDITION ANNUNCIATOR
ISS CAUTION ON CONDITION ANNUNCIATOR AND MASTER CAUTION
CMC WARNING ON CONDITION ANNUNCIATOR AND MASTER CAUTION
UPLINK ACTY
TEMP
NO ATT
GIMBAL LOCK
STBY
PROG
KEY REL
RESTART
OPR ERR
TRACKER
COMP ACTY
PROG
VERB
NOUN
CH11B4
CH11B1
CH10 = (60400)8 FOR SET
CH10 = (60040)8 FOR SET
CH10 = (60020)8 FOR SET
CH10 = (60200)8 FOR SET
SET
DSTAB 11D BIT 9 FF
DSTAB 11D BIT 6 FF
DSTAB 11D BIT 4 FF
DSTAB 11D BIT 8 FF
RESET
CH33B14
CMC WARNING
I MODES 30 B 15
I MODES 30 B 12
I MODES 30 B 13
CH30B15
PIP USE
PIPA FAIL DETECT
PIP FREE
GIMBAL LOCK DETECT
V FAIL
STANDBY
VOLTAGE ALARM CIRCUIT
STRT 1
SCALOR 200 PPS
DOUBLE SCALOR FREQ ALARM
LOSS OF SIG 15
SCALOR ALARM
LOGIC ALARM
OSC ALARM
DSKY
DOWNLIST
+ DRIVE ENABLE
- DRIVE ENABLE
FROM TVC DAP
CDU DRIVE


CH32B3
CH32B4
CH32B2
CH32B1
CH32B5
CH32B6
TEMP WITHIN LIMITS
CH30B12
ISS CDU FAIL
CH30B13
IMU FAIL
CH33B13
PIPA FAIL
PIPA COUNTS
MARK RESET
CH16B6
MARK
CH16B7
MARK REJECT
MG CDU INPUT CTR NO 34
MARK REJECT LHEB 122 S7
MARK LHEB 122 S6
OPTICS CONTROLLER COUPLING
DIRECT
RSLV
LHEB 122 S4
ROLL IN
ROLL LEFT
ROLL RIGHT
PITCH IN
PITCH UP
LHEB 122
ATTITUDE IMPULS
OPTICS MODE
CMC
MAN
LHEB 122 S2
OPTICS ZERO
ZERO
OFF
LHEB 122 S3
CMC
MANUAL ZERO OPTICS
OSS CDU FAIL
CH30B7
CH33B4
CH33B5
OPTICS TELESCOPE TRUNNION
SLAVE TO SXT 0° 25°
LHEB 122 S1
SLAVE TO SXT
0° OFFSET
25° OFFSET
12K6
12K2
12K4
12K3
23K1
23K2
23K3
OPTICS SEXTANT HAND CONTROLLER
LHEB 122 A1
11K1 AND 11K2 ALLOW 2 SPEED SWITCHES TO PASS RESOLVER SIGNALS TO DRIVE AMP FOR OPTICS ZEROING BY CMC/CDU OR BY ZERO OPTICS SELECT
DISENGAGE OPTICS DAC
CH12B11
CH12B10
CMC ENABLE ZERO OPTICS
20K2
20K1
13K3
13K5
13K2
13K1
11K1
11K2
GND'S HC INPUT FOR CMC/CDU OR HAND CONT ZERO INPUTS
SELECT CMC/CDU INPUT
TACH GAIN HI FOR DAC DISENGAGE TO HOLD OPTICS
TACH FDBK GAIN LOW WHEN ENERG FOR ZEROING THE OPTICS
OPTICS CDU FAIL
COS (θ-ψ)< 3.5 V OR 14V SUPPLY < 10 VDC
T COS (θ-ψ)
S COS (θ-ψ)
+ 14 VDC
(θ-ψ) > 0.5° SHAFT
(θ-ψ) > .125° TRUN
T FINE ERROR
S FINE ERROR
LIMIT CYCLE >250 HZ
T LIMIT CYCLE
S LIMIT CYCLE
1600 PPS
INTERROGATE GENERATOR
LOW LEVEL TERNARY
R1 = 800 HZ SQ WAVE
R2 = R1 / 180°
UP - DOWN LOGIC
U = S·R2
D = S·R1
SELECTED ERROR LOGIC
S = 1·F1
F1 (θ-ψ) > 10 SEC TRUN
(θ-ψ) > 80 SEC SHAFT
DIVIDE BY 4
CMC LOGIC
+Δθ G = Δ2*·U
-Δθ G = Δ2*·D
READ COUNTER 16 STAGE 2¹ - 2¹⁵
RATE SELECT LOGIC HIGH RATE = Φ 4·S·F2 LOW RATE = S·F2
(θ-ψ) > 100 SEC TRUNN (θ-ψ) > 0.1° SHAFT
HIGH LEVEL TERNARY
INPUT COUNTERS 0034 (T) 0035 (S)
+Δθ G ≈ 40 SHAFT PULSE / SEC
-Δθ G ≈ 5 TRUNN PULSE / SEC
PULSE INCREMENT PI = PG · Y·G
PULSE SELECTION G = CA·Δθ C2·N PE = E·N· (Δθ C2 = CA·Δ2²)
51.2 KPS
CDU CLOCK
Φ1 12.8 KPPS
Φ2 12.8 KPPS
Φ3 12.8 KPPS
Φ4 12.8 KPPS
OPTICS MODING SYNC LOGIC Z' = Z+T Y = Z SYNC TO Φ2 CA = E-T
DRIVE PULSES
CH14B11
160 SEC / PULSE (OPTICS MODE)
90 SEC / PULSE (TVC MODE)
TVC ENABLE
CH12B8
ZERO OPTICS
CH12B1
ENABLE OPTICS ERROR CNTR
CH12B2
OPTICS MODING BUFFERS
SINGLE PULSE SYNC - (PUTS Δ θ C IN CDU TIME
-Δθ C PRESENT
+Δθ C PRESENT
Φ1 AND Φ3 TIME
DAC
UBC
PULSE SELECTION DA = D θC + X·CA·U UP = U θC + X·CA·D
D/A POLARITY +PDA = UP·2D -PDA = DP·2D
UP
DP


J
I
H
G
F
YAW IN
YAW LEFT
YAW RIGHT
PITCH DOWN
S8
RESOLVER B5 1X
RESOLVER B7 1/2X
RESOLVER B4 16X
RESOLVER B6 1X
RESOLVER B2 2X
RESOLVER B1 64X
RESOLVER B3 1X
11K2
12
COARSE OUT
13K4 (NOT USED)
P1
P2
P3
P4
P5
S4
S2
TO CMC
CG3721V SHAFT CDU DAC OUT -10 TO +10 VRMS 10 S/S
ECDU SHAFT OPTIC SHAFT AXIS (SEE TRUNNION BELOW)
SPS PITCH GIMBAL DRIVE TVC MODE
TACH
SEXTANT SHAFT MOTOR DRIVE
AS COS Φ - AT SIN Θ S 2 SIN AT LOS
SEXTANT TRUNNION MOTOR DRIVE
AT COS AS + AS SIN AS
OPTICS
SPEED
SHAFT
TRUNNION
HI
MED
LO
LHEB 122
S1
12K6
12K5 (NOT USED)
12K4
13K3
(NOT USED) 12K1
11K1
23K1
0 OR 25° OFF SET ENERGIZED
TRUNNION ECDU
FINE ERROR GENERATOR SIN 16 (Θ-φ)(S) SIN 64 (Θ-φ)(T)
OPTICS TRUNNION
5 SIN 64 Θ
5 COS 64 Θ
OPTICS DAC ERROR SIGNAL CONDITIONER
CG3722V TRUNNION CDU OUT -10 TO +10 VRMS 10 S/S
ERROR COUNTER INPUT 2*
D/A POLARITY SWITCH
LADDER NETWORK $V_{OUT} = V_{IN} X / 384$
V_{IN}
V OUT
SCALING
DEMOD
SPS GIMBAL CONTROL 0.55 VDC/DEG = 90 SEC COMP BIT
TVC CONTROL FROM S/C
TVC ENABLE
+PDA
-PDA



1 ALL OF THE INPUT SIGNALS IN CHANNELS 30-33 ARE INVERTED, ZERO INDICATES THAT THE SIGNAL IS PRESENT.

6 OPTICS

SIGNATURES	DATE
DR	
DSGN	
QC	
ENGR	
NR	
APP	
FEC	
AUTH	

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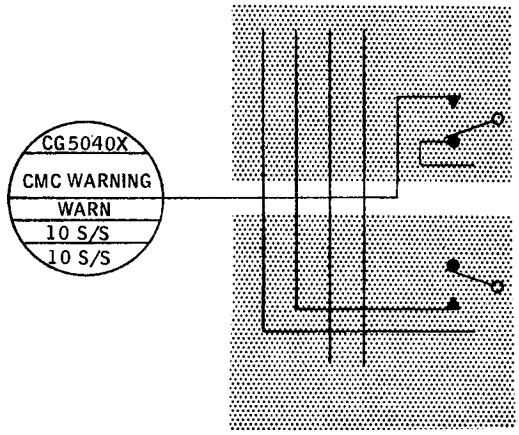
OPTICS SUBSYSTEM

CSM 103/104 | SIZE J | DWG NO 8.6 | SHEET 1 OF 1

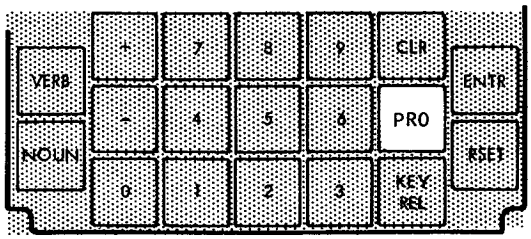
110 X 34.25

IS

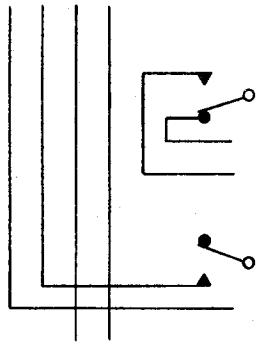
1. DWG 8.6 S Z 5,4

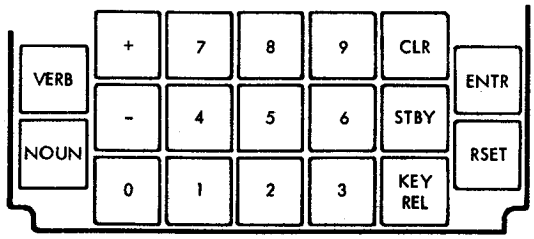


2. DWG 8.6 S,R Z 2



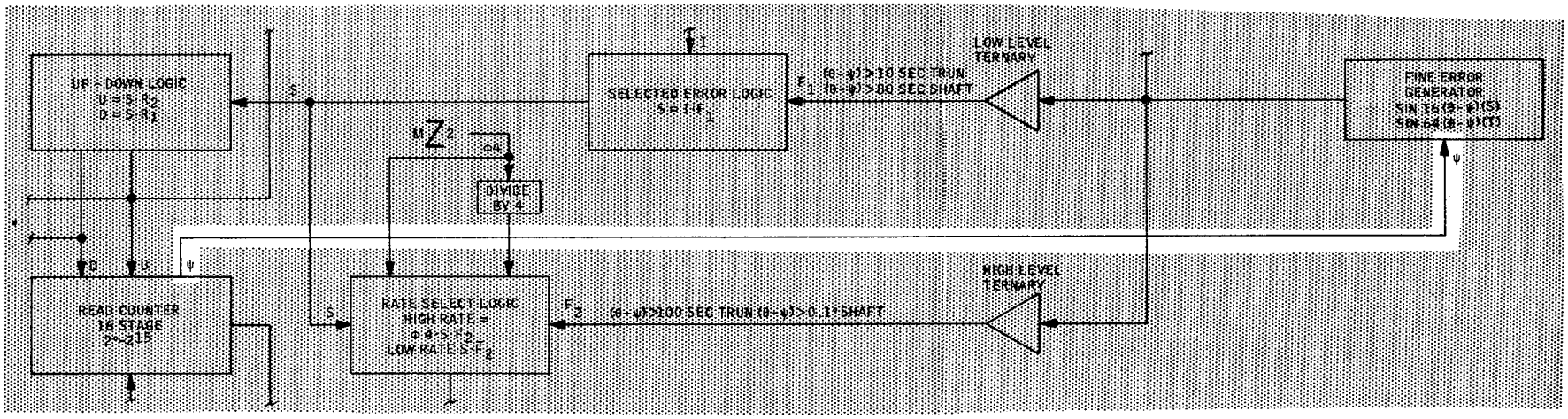
WAS





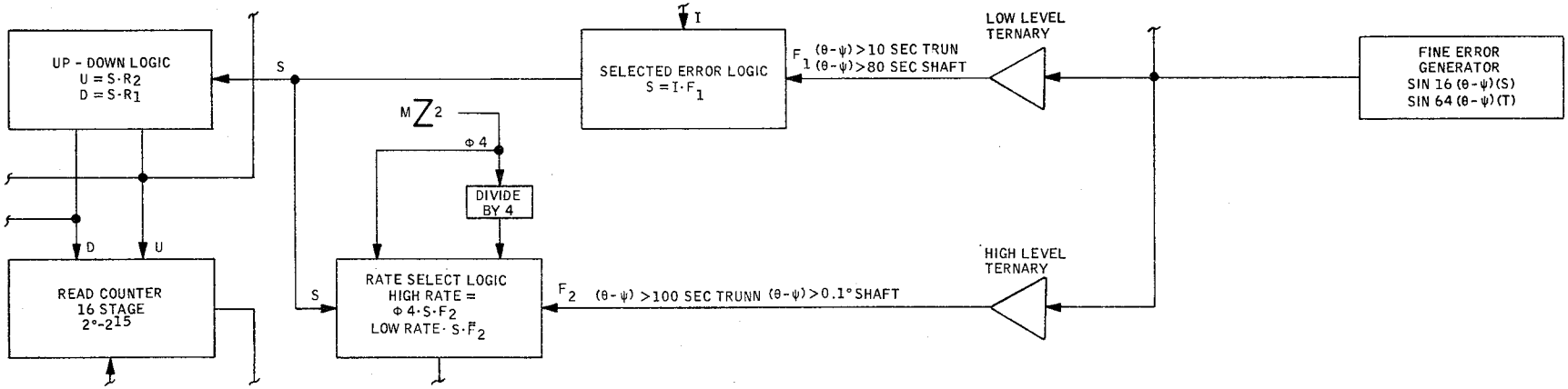
CSM S/C 104 PCN 1

IS

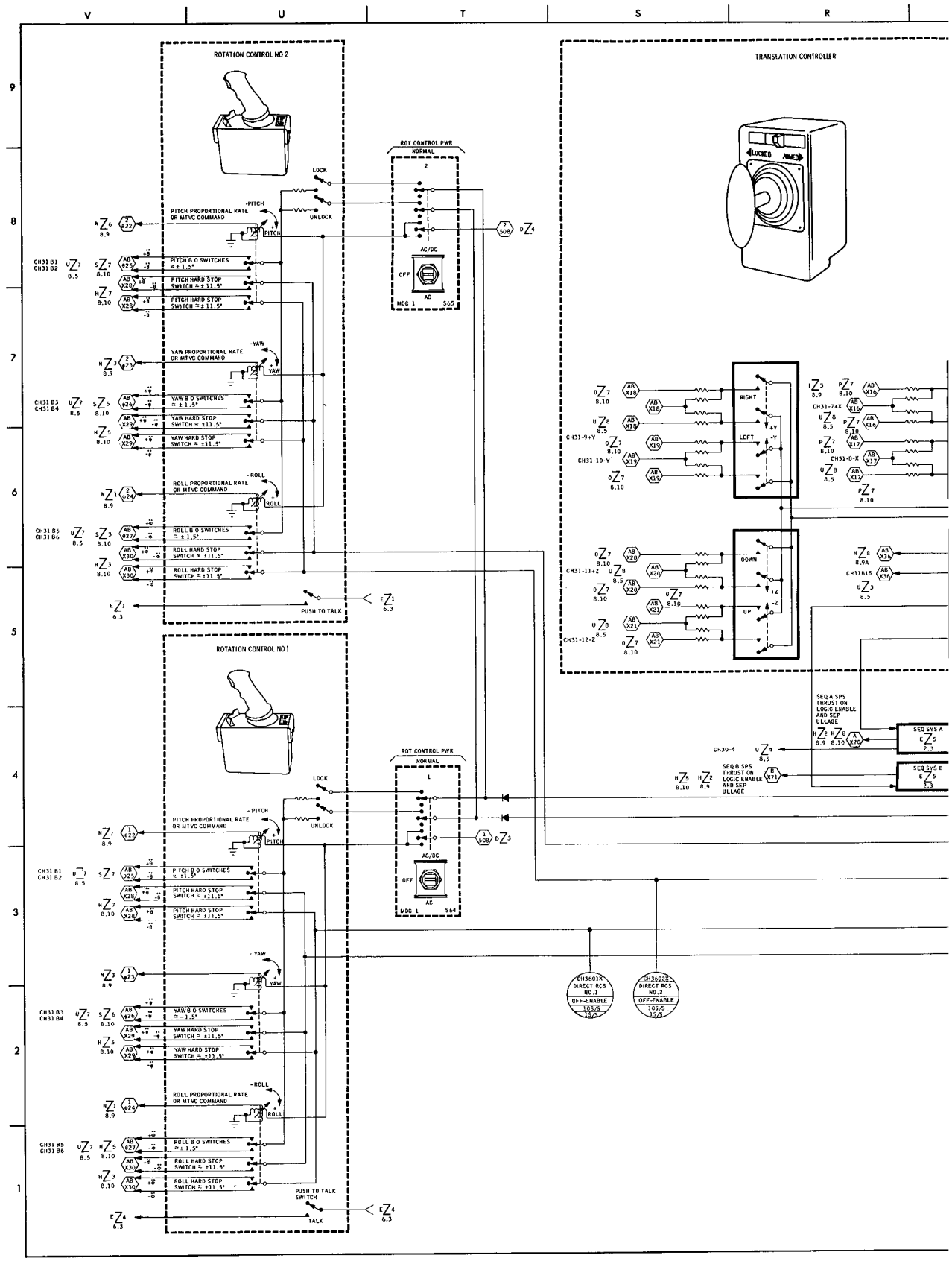


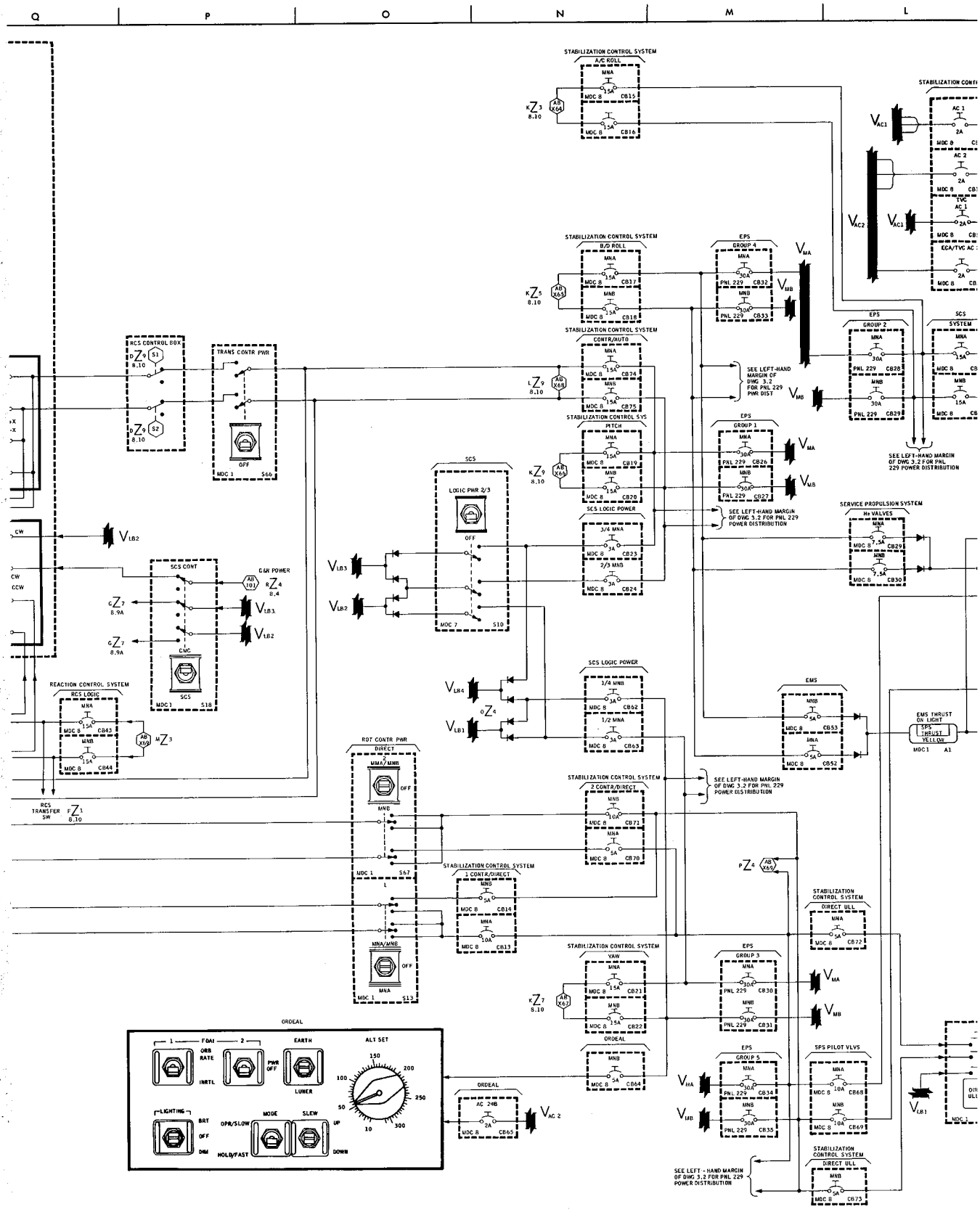
SECTION 8

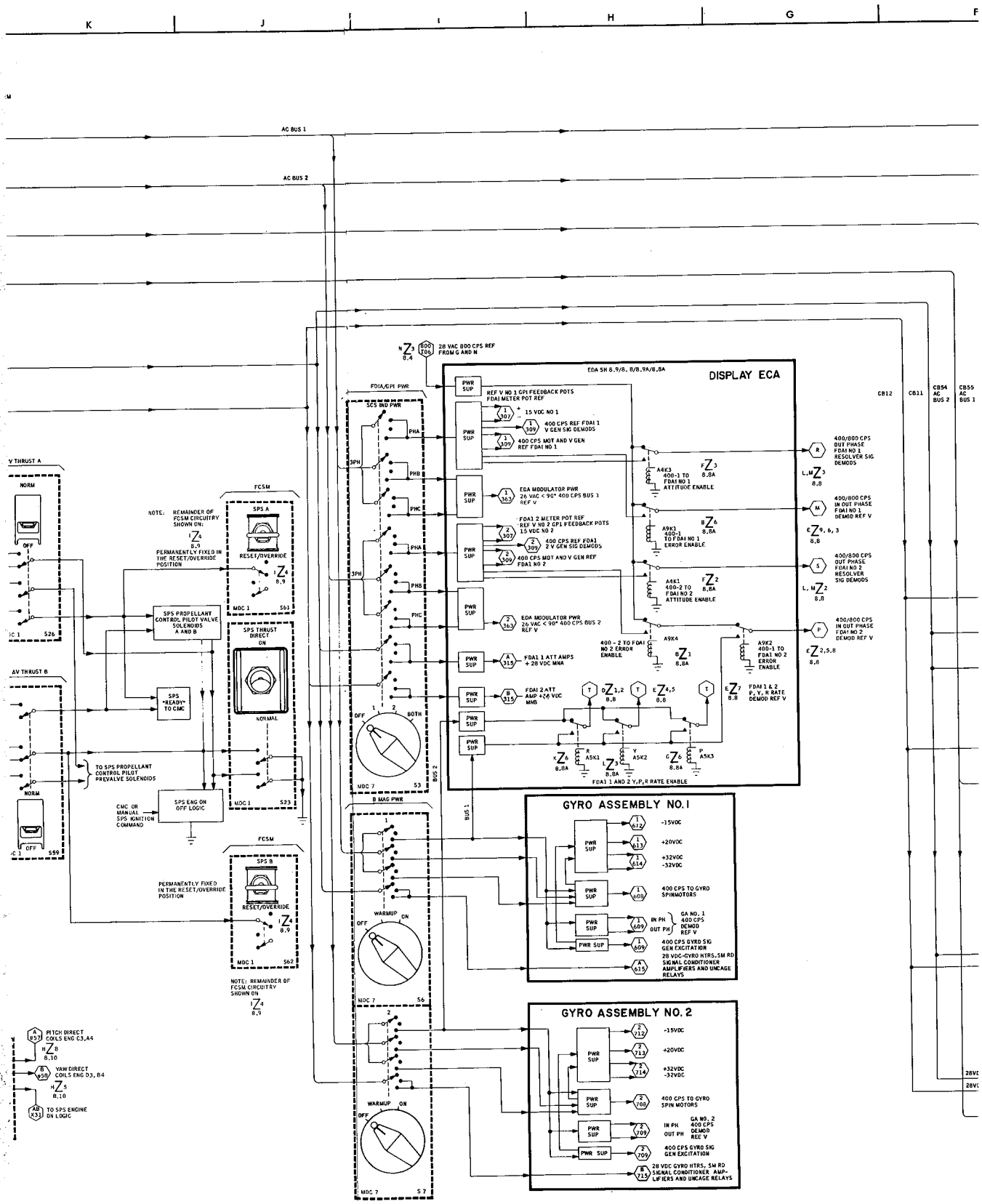
WAS

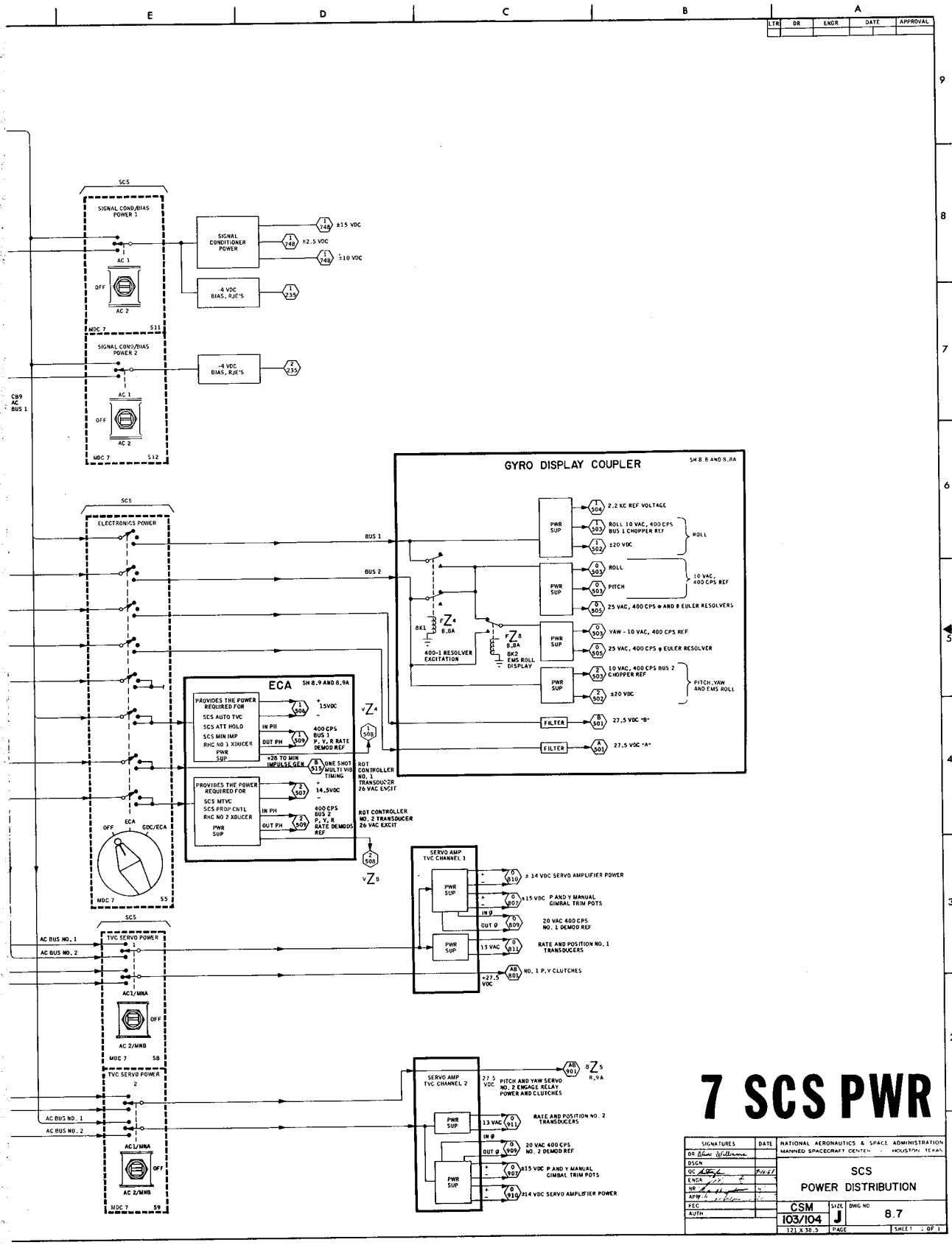


3. DWG 8.6 M,L,K,J $Z_{4,3}$


V
U
T
S
R
9
8
7
6
5
4
3
2
1
ROTATION CONTROL NO 2
ROT CONTROL PWR
NORMAL
LOCK
UNLOCK
-PITCH
PITCH PROPORTIONAL RATE OR MTVC COMMAND
PITCH
PITCH B O SWITCHES ≈ ± 1.5°
PITCH HARD STOP SWITCH ≈ ± 11.5°
PITCH HARD STOP SWITCH ≈ ± 11.5°
AC/DC
OFF
AC
MDC 1
S65
-YAW
YAW PROPORTIONAL RATE OR MTVC COMMAND
YAW
YAW B O SWITCHES ≈ ± 1.5°
YAW HARD STOP SWITCH ≈ ±11.5°
YAW HARD STOP SWITCH ≈ ±11.5°
-ROLL
ROLL PROPORTIONAL RATE OR MTVC COMMAND
ROLL
ROLL B O SWITCHES ≈ ± 1.5°
ROLL HARD STOP SWITCH ≈ ±11.5°
ROLL HARD STOP SWITCH ≈ ±11.5°
PUSH TO TALK
CH31 B1
CH31 B2
CH31 B3
CH31 B4
CH31 B5
CH31 B6
ROTATION CONTROL NO 1
ROT CONTROL PWR
NORMAL
LOCK
UNLOCK
- PITCH
PITCH PROPORTIONAL RATE OR MTVC COMMAND
PITCH
PITCH B O SWITCHES ≈ ±1.5°
PITCH HARD STOP SWITCH ≈ ±11.5°
PITCH HARD STOP SWITCH ≈ ±11.5°
AC/DC
OFF
AC
MDC 1
S64
- YAW
YAW PROPORTIONAL RATE OR MTVC COMMAND
YAW
YAW B O SWITCHES ≈ ± 1.5°
YAW HARD STOP SWITCH ≈ ±11.5°
YAW HARD STOP SWITCH ≈ ±11.5°
-ROLL
ROLL PROPORTIONAL RATE OR MTVC COMMAND
ROLL
ROLL B O SWITCHES ≈ ± 1.5°
ROLL HARD STOP SWITCH ≈ ±11.5°
ROLL HARD STOP SWITCH ≈ ±11.5°
PUSH TO TALK SWITCH
TALK
CH31 B1
CH31 B2
CH31 B3
CH31 B4
CH31 B5
CH31 B6
TRANSLATION CONTROLLER
LOCKED
ARMED
RIGHT
LEFT
+Y
-Y
DOWN
UP
+Z
-Z
CH31-9+Y
CH31-10-Y
CH31-7+X
CH31-8-X
CH31-11+Z
CH31-12-Z
SEQ A SPS THRUST ON LOGIC ENABLE AND SEP ULLAGE
SEQ B SPS THRUST ON LOGIC ENABLE AND SEP ULLAGE
SEQ SYS A
SEQ SYS B
CH30-4
CH3601X DIRECT RCS NO.1 OFF-ENABLE 10S/S 15/S
CH3602X DIRECT RCS NO.2 OFF-ENABLE 10S/S 15/S


Q
P
O
N
M
L
STABILIZATION CONTROL SYSTEM
A/C ROLL
B/D ROLL
CONTR/AUTO
PITCH
YAW
1 CONTR/DIRECT
2 CONTR/DIRECT
DIRECT ULL
EPS
GROUP 1
GROUP 2
GROUP 3
GROUP 4
GROUP 5
SCS
SYSTEM
LOGIC PWR 2/3
SCS LOGIC POWER
SCS CONT
SCS
CMC
G&N POWER
RCS CONTROL BOX
TRANS CONTR PWR
REACTION CONTROL SYSTEM
RCS LOGIC
RCS TRANSFER SW
RDT CONTR PWR
DIRECT
SERVICE PROPULSION SYSTEM
He VALVES
EMS
EMS THRUST ON LIGHT
SPS THRUST YELLOW
SPS PILOT VLVS
EGA/TVC AC
SEE LEFT-HAND MARGIN OF DWG 3.2 FOR PNL 229 PWR DIST
SEE LEFT-HAND MARGIN OF DWG 3.2 FOR PNL 229 POWER DISTRIBUTION
SEE LEFT - HAND MARGIN OF DWG 3.2 FOR PNL 229 POWER DISTRIBUTION
ORDEAL
FDAI
ORB RATE
INRTL
PWR OFF
EARTH
LUNER
ALT SET
LIGHTING
BRT
OFF
DIM
MODE
SLEW
OPR/SLOW
HOLD/FAST
UP
DOWN
AC 2
AC 1
TVC
MDC 1
MDC 2
MDC 7
MDC 8
PNL 229

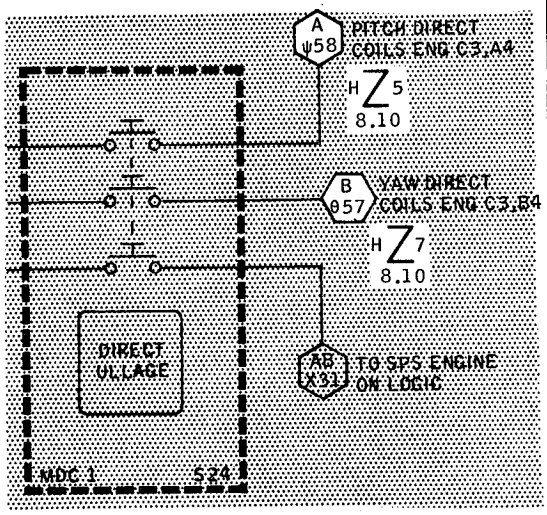

K
J
H
G
F
AC BUS 1
AC BUS 2
28 VAC 800 CPS REF FROM G AND N
DISPLAY ECA
EDA SH 8.9/8, 8/8.9A/8.8A
FDIA/GPI PWR
SCS IND PWR
B MAG PWR
BUS 2
BUS 1
REF V NO 1 GPI FEEDBACK POTS
FDAI METER POT REF
15 VDC NO 1
400 CPS REF FDAI 1 V GEN SIG DEMODS
400 CPS MOT AND V GEN REF FDAI NO 1
EDA MODULATOR PWR 26 VAC < 90° 400 CPS BUS 1 REF V
FDAI 2 METER POT REF REF V NO 2 GPI FEEDBACK POTS 15 VDC NO 2
400 CPS REF FDAI 2 V GEN SIG DEMODS
400 CPS MOT AND V GEN REF FDAI NO 2
EDA MODULATOR PWR 26 VAC < 90° 400 CPS BUS 2 REF V
FDAI 1 ATT AMPS + 28 VDC MNA
FDAI 2 ATT AMP +28 VDC MNB
FDAI 1 AND 2 Y,P,R RATE ENABLE
FDAI 1 & 2 P, Y, R RATE DEMOD REF V
A4K3 400-1 TO FDAI NO 1 ATTITUDE ENABLE
A9K3 400-3 TO FDAI NO 1 ERROR ENABLE
A4K1 400-2 TO FDAI NO 2 ATTITUDE ENABLE
A9K4 400-2 TO FDAI NO 2 ERROR ENABLE
A9K2 400-1 TO FDAI NO 2 ERROR ENABLE
400/800 CPS OUT PHASE FDAI NO 1 RESOLVER SIG DEMODS
400/800 CPS IN OUT PHASE FDAI NO 1 DEMOD REF V
400/800 CPS OUT PHASE FDAI NO 2 RESOLVER SIG DEMODS
400/800 CPS IN OUT PHASE FDAI NO 2 DEMOD REF V
GYRO ASSEMBLY NO. 1
-15VDC
+20VDC
+32VDC -32VDC
400 CPS TO GYRO SPINMOTORS
GA NO. 1 400 CPS DEMOD REF V
400 CPS GYRO SIG GEN EXCITATION
28 VDC-GYRO HTRS, SM RD SIGNAL CONDITIONER AMPLIFIERS AND UNCAGE RELAYS
GYRO ASSEMBLY NO. 2
-15VDC
+20VDC
+32VDC -32VDC
400 CPS TO GYRO SPIN MOTORS
GA NO. 2 400 CPS DEMOD REF V
400 CPS GYRO SIG GEN EXCITATION
28 VDC GYRO HTRS, SM RD SIGNAL CONDITIONER AMPLIFIERS AND UNCAGE RELAYS
V THRUST A
ΔV THRUST B
NORM
OFF
SPS PROPELLANT CONTROL PILOT VALVE SOLENOIDS A AND B
SPS "READY" TO CMC
TO SPS PROPELLANT CONTROL PILOT PREVALVE SOLENOIDS
CMC OR MANUAL SPS IGNITION COMMAND
SPS ENG ON OFF LOGIC
FCSM
SPS A
RESET/OVERRIDE
SPS THRUST DIRECT ON
NORMAL
SPS B
PERMANENTLY FIXED IN THE RESET/OVERRIDE POSITION
NOTE: REMAINDER OF FCSM CIRCUITRY SHOWN ON
PERMANENTLY FIXED IN THE RESET/OVERRIDE POSITION
PITCH DIRECT COILS ENG C3, A4
YAW DIRECT COILS ENG D3, B4
TO SPS ENGINE ON LOGIC
WARMUP
ON
OFF
BOTH
MDC 1
MDC 7
S26
S59
S61
S23
S62
S3
S6
S7


LTR DR ENGR DATE APPROVAL
SCS
SIGNAL COND/BIAS POWER 1
AC 1
OFF
AC 2
MDC 7 S11
SIGNAL CONDITIONER POWER
±15 VDC
±2.5 VDC
±10 VDC
-4 VDC BIAS, RJE'S
SIGNAL COND/BIAS POWER 2
MDC 7 S12
CB9 AC BUS 1
GYRO DISPLAY COUPLER
SH 8.8 AND 8.8A
PWR SUP
2.2 KC REF VOLTAGE
ROLL 10 VAC, 400 CPS BUS 1 CHOPPER REF
±20 VDC
ROLL
10 VAC, 400 CPS REF
PITCH
25 VAC, 400 CPS Φ AND θ EULER RESOLVERS
YAW - 10 VAC, 400 CPS REF
25 VAC, 400 CPS Φ EULER RESOLVER
10 VAC, 400 CPS BUS 2 CHOPPER REF
±20 VDC
PITCH, YAW AND EMS ROLL
FILTER
27.5 VDC "B"
27.5 VDC "A"
8K1
400-1 RESOLVER EXCITATION
8K2 EMS ROLL DISPLAY
SCS
ELECTRONICS POWER
BUS 1
BUS 2
ECA
SH 8.9 AND 8.9A
PROVIDES THE POWER REQUIRED FOR
SCS AUTO TVC
SCS ATT HOLD
SCS MIN IMP
RHC NO 1 XDUCER
PWR SUP
+15VDC
IN PH
OUT PH
400 CPS BUS 1 P, Y, R RATE DEMOD REF
+28 TO MIN IMPULSE GEN
ONE SHOT MULTI VIB TIMING
RGT CONTROLLER NO. 1 TRANSDUCER 26 VAC EXCIT
PROVIDES THE POWER REQUIRED FOR
SCS MTVC
SCS PROP CNTL
RHC NO 2 XDUCER
PWR SUP
+14.5VDC
400 CPS BUS 2 P, Y, R RATE DEMODS REF
RGT CONTROLLER NO. 2 TRANSDUCER 26 VAC EXCIT
ECA
OFF
GDC/ECA
MDC 7 S5
SCS
TVC SERVO POWER 1
AC BUS NO. 1
AC BUS NO. 2
AC1/MNA
OFF
AC 2/MNB
MDC 7 S8
TVC SERVO POWER 2
AC BUS NO. 1
AC BUS NO. 2
AC1/MNA
OFF
AC 2/MNB
MDC 7 S9
SERVO AMP TVC CHANNEL 1
PWR SUP
±14 VDC SERVO AMPLIFIER POWER
±15 VDC P AND Y MANUAL GIMBAL TRIM POTS
IN φ
OUT φ
20 VAC 400 CPS NO. 1 DEMOD REF
13 VAC
RATE AND POSITION NO. 1 TRANSDUCERS
+27.5 VDC
NO. 1 P, Y CLUTCHES
SERVO AMP TVC CHANNEL 2
PWR SUP
27.5 VDC
PITCH AND YAW SERVO NO. 2 ENGAGE RELAY POWER AND CLUTCHES
13 VAC
RATE AND POSITION NO. 2 TRANSDUCERS
IN φ
OUT φ
20 VAC 400 CPS NO. 2 DEMOD REF
±15 VDC P AND Y MANUAL GIMBAL TRIM POTS
±14 VDC SERVO AMPLIFIER POWER
7 SCS PWR
SIGNATURES
DR
DSGN
QC
ENGR
NR
APPR
FEC
AUTH
DATE
NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER - HOUSTON, TEXAS
SCS
POWER DISTRIBUTION
CSM
103/104
SIZE J
DWG NO 8.7
121 X 38.5
PAGE
SHEET 1 OF 1

SECTION 8

IS

1. DWG 8.7 L,K Z 2



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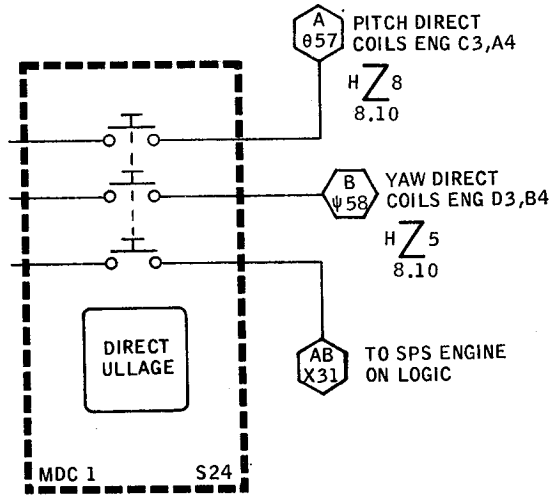
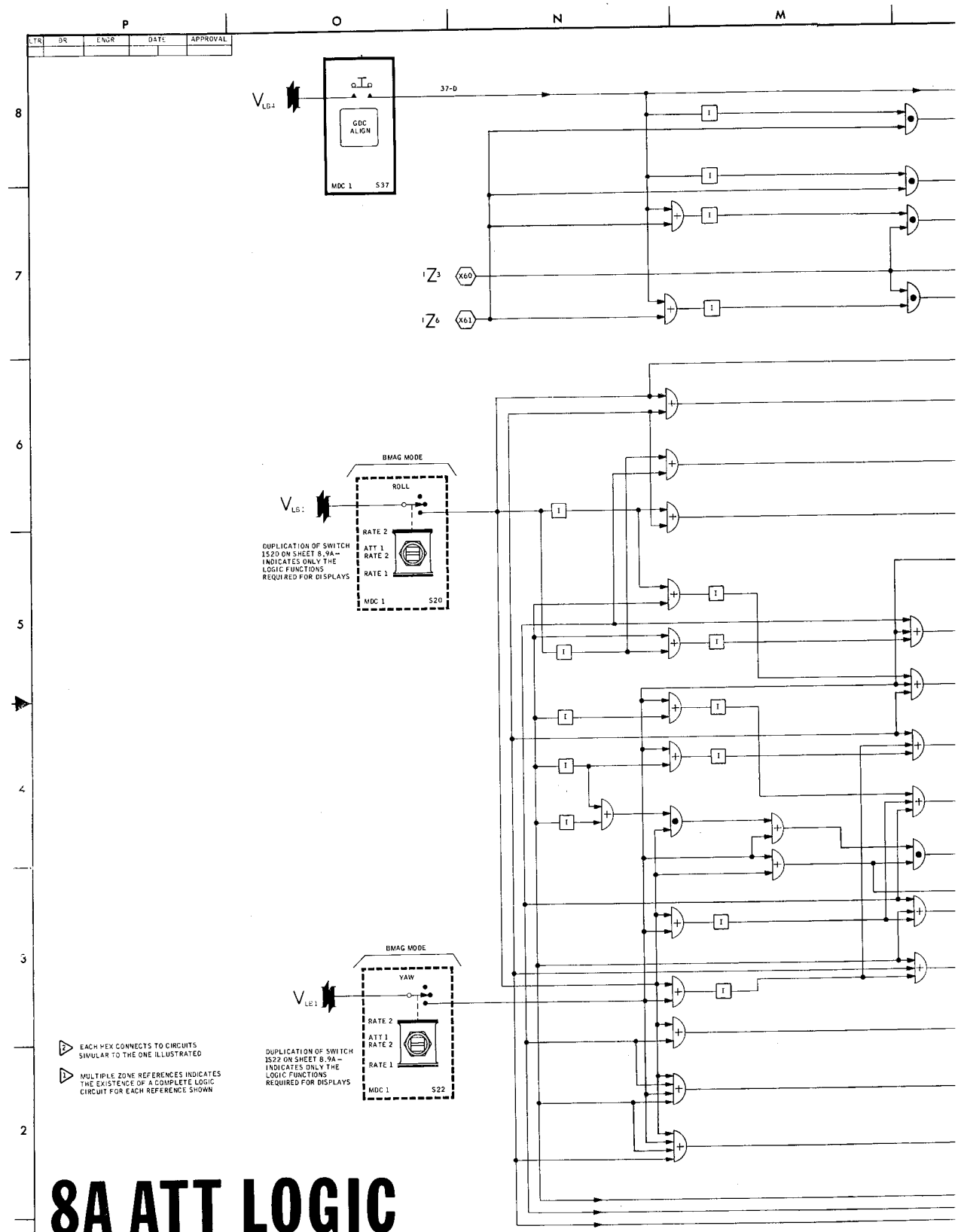
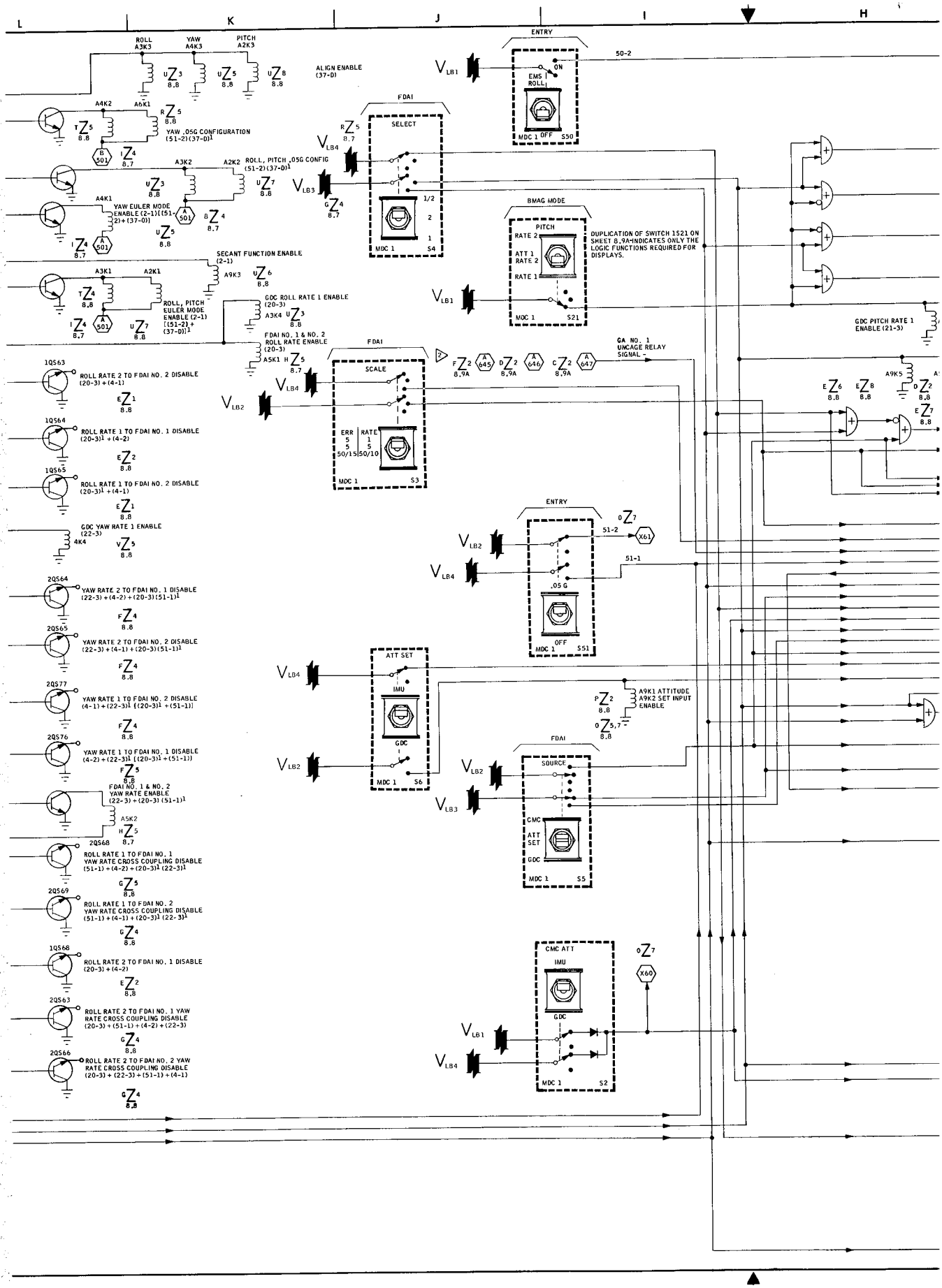
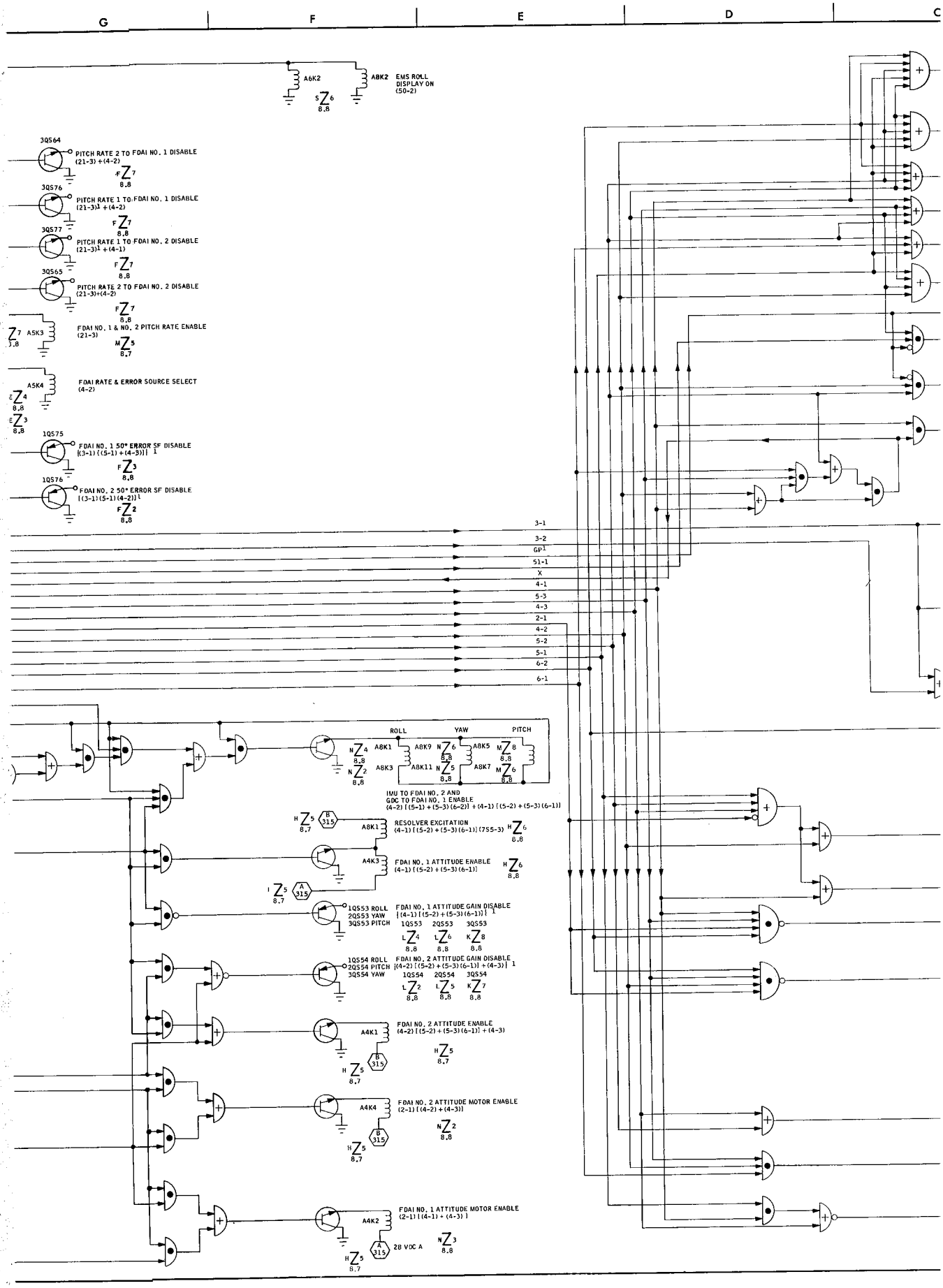


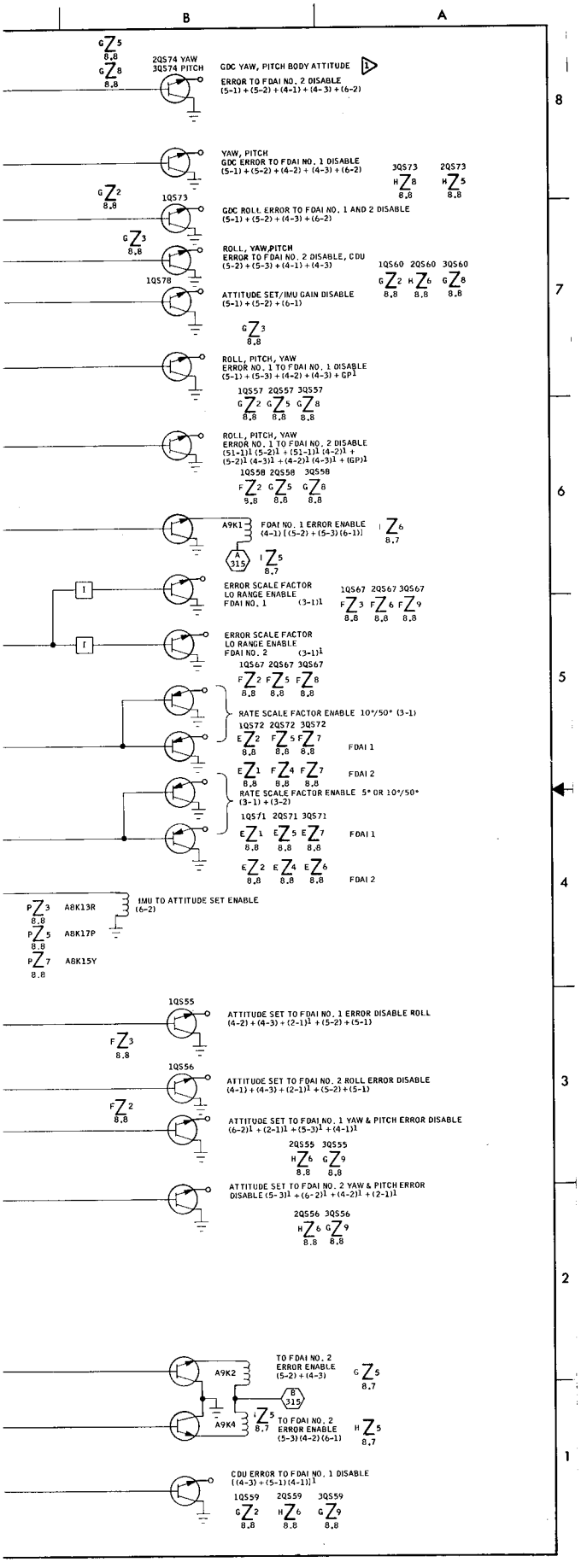


8A ATT LOGIC

NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER · HOUSTON, TEXAS		SIGNATURES	DATE
SCS ATTITUDE REFERENCE LOGIC		DR	
		DSGN	
		QC	9-1-67
		ENGR	
		NR	
		APF	
DWG NO. 8.8A	SIZE J	FEC	
	CSM 104	AUTH	
SHEET 1 OF 1 PAGE			

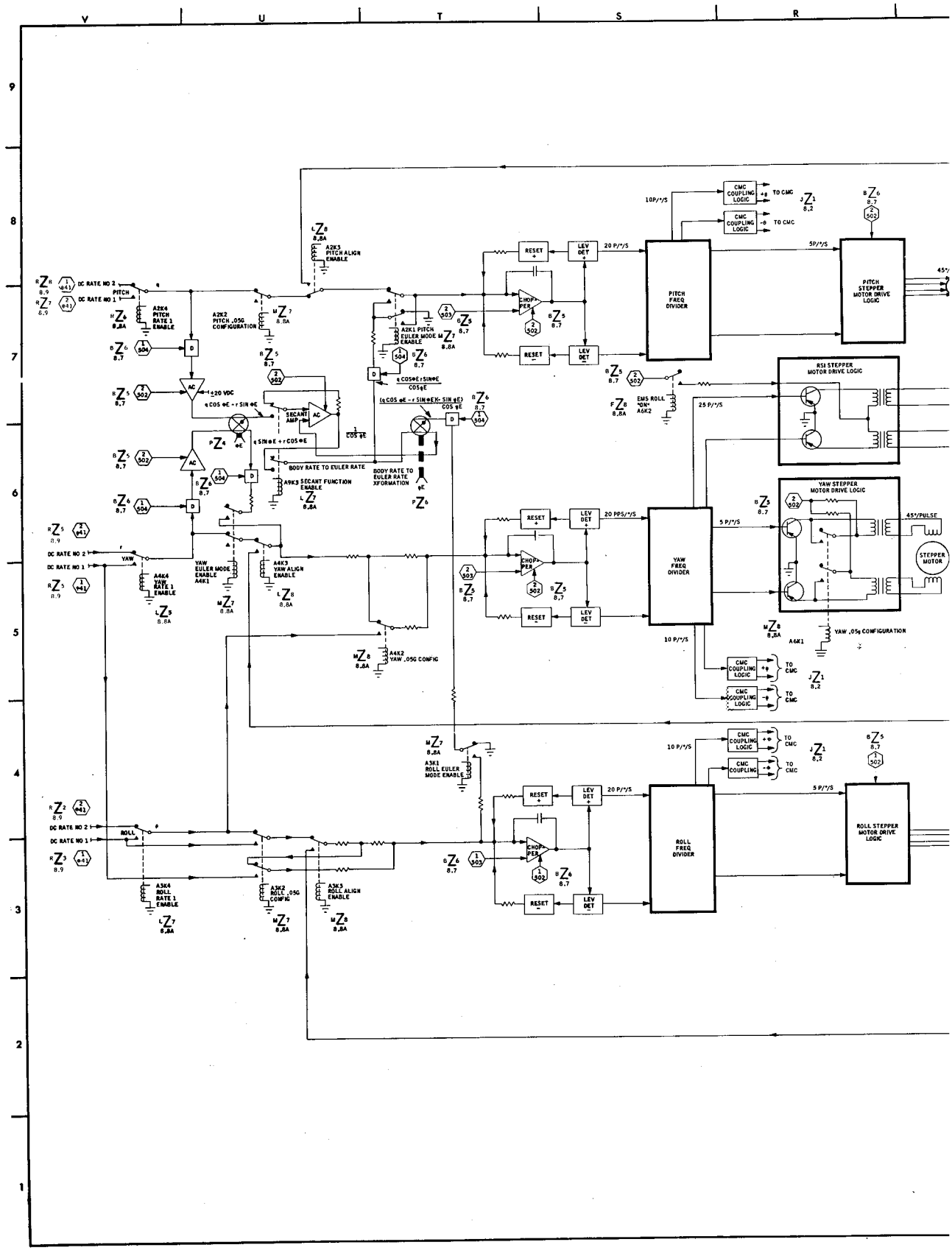

L
K
J
I
H
ROLL A3K3
YAW A4K3
PITCH A2K3
ALIGN ENABLE (37-D)
ENTRY
EMS ROLL
ON
50-2
MDC 1 OFF S50
FDAI
SELECT
MDC 1 S4
YAW .05G CONFIGURATION (51-2)(37-D)1
ROLL, PITCH .05G CONFIG (51-2)(37-D)1
YAW EULER MODE ENABLE (2-1)((51-2)+(37-D))
SECANT FUNCTION ENABLE (2-1)
ROLL, PITCH EULER MODE ENABLE (2-1)((51-2)+(37-D))1
BMAG MODE
PITCH
RATE 2
ATT 1 RATE 2
RATE 1
MDC 1 S21
DUPLICATION OF SWITCH 1S21 ON SHEET 8,9A-INDICATES ONLY THE LOGIC FUNCTIONS REQUIRED FOR DISPLAYS.
GDC ROLL RATE 1 ENABLE (20-3)
FDAI NO. 1 & NO. 2 ROLL RATE ENABLE (20-3)
GDC PITCH RATE 1 ENABLE (21-3)
GA NO. 1 UNCAGE RELAY SIGNAL
SCALE
ERR 5 5 50/15
RATE 1 5 50/10
MDC 1 S3
1QS63 ROLL RATE 2 TO FDAI NO. 2 DISABLE (20-3)+(4-1)
1QS64 ROLL RATE 1 TO FDAI NO. 1 DISABLE (20-3)1+(4-2)
1QS65 ROLL RATE 1 TO FDAI NO. 2 DISABLE (20-3)1+(4-1)
GDC YAW RATE 1 ENABLE (22-3)
2QS64 YAW RATE 2 TO FDAI NO. 1 DISABLE (22-3)+(4-2)+(20-3)(51-1)1
2QS65 YAW RATE 2 TO FDAI NO. 2 DISABLE (22-3)+(4-1)+(20-3)(51-1)1
2QS77 YAW RATE 1 TO FDAI NO. 2 DISABLE (4-1)+(22-3)1((20-3)1+(51-1))
2QS76 YAW RATE 1 TO FDAI NO. 1 DISABLE (4-2)+(22-3)1((20-3)1+(51-1))
FDAI NO. 1 & NO. 2 YAW RATE ENABLE (22-3)+(20-3)(51-1)1
2QS68 ROLL RATE 1 TO FDAI NO. 1 YAW RATE CROSS COUPLING DISABLE (51-1)+(4-2)+(20-3)1(22-3)1
2QS69 ROLL RATE 1 TO FDAI NO. 2 YAW RATE CROSS COUPLING DISABLE (51-1)+(4-1)+(20-3)1(22-3)1
1QS68 ROLL RATE 2 TO FDAI NO. 1 DISABLE (20-3)+(4-2)
2QS63 ROLL RATE 2 TO FDAI NO. 1 YAW RATE CROSS COUPLING DISABLE (20-3)+(51-1)+(4-2)+(22-3)
2QS66 ROLL RATE 2 TO FDAI NO. 2 YAW RATE CROSS COUPLING DISABLE (20-3)+(22-3)+(51-1)+(4-1)
ENTRY
51-2
51-1
.05 G
OFF
MDC 1 S51
ATT SET
IMU
GDC
MDC 1 S6
A9K1 ATTITUDE A9K2 SET INPUT ENABLE
FDAI
SOURCE
CMC
ATT SET
GDC
MDC 1 S5
CMC ATT
IMU
GDC
MDC 1 S2

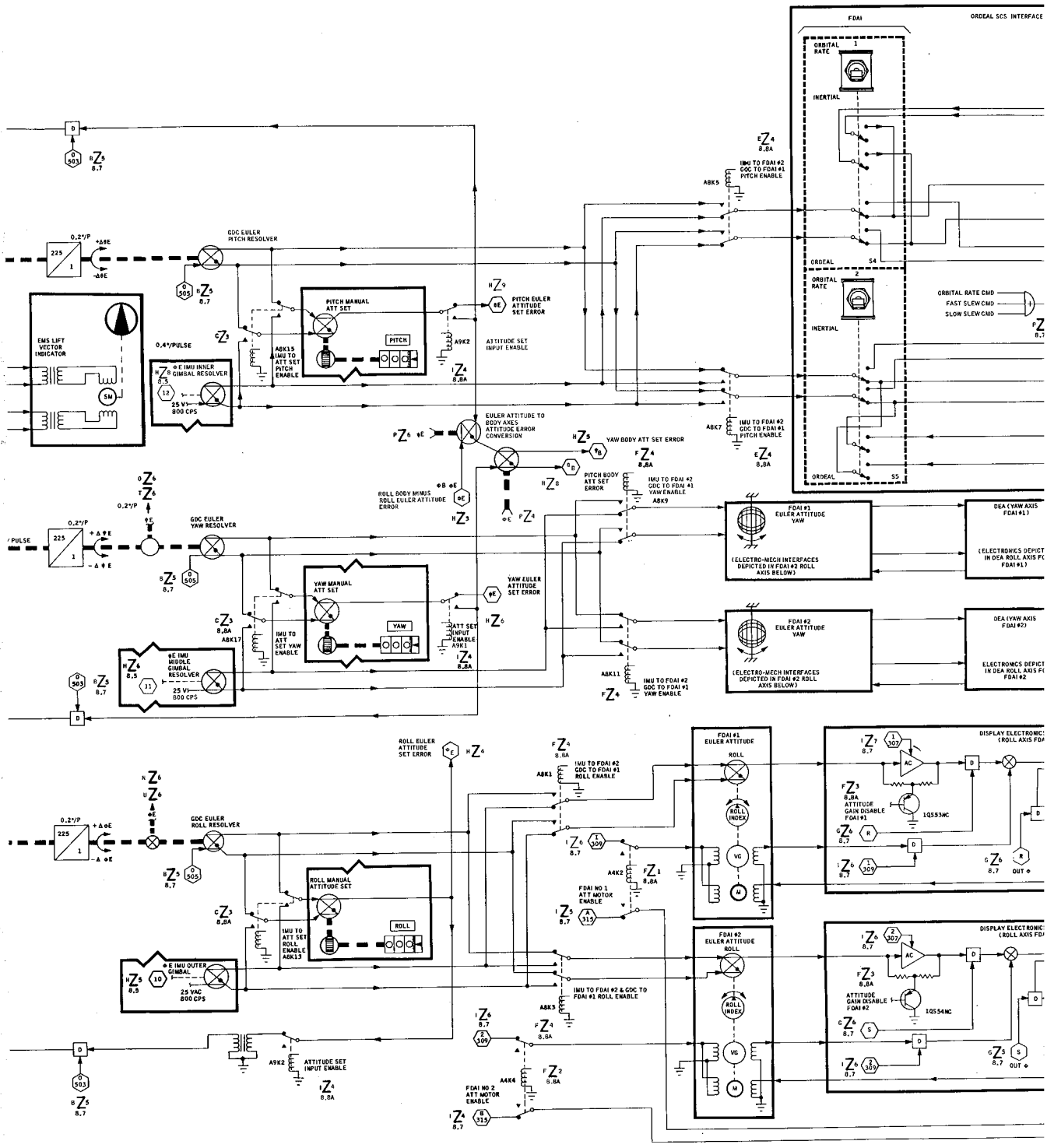

G
F
E
D
C
A6K2
A8K2 EMS ROLL DISPLAY ON (50-2)
3QS64
PITCH RATE 2 TO FDAI NO. 1 DISABLE (21-3)+(4-2)
3QS76
PITCH RATE 1 TO FDAI NO. 1 DISABLE (21-3)1 +(4-2)
3QS77
PITCH RATE 1 TO FDAI NO. 2 DISABLE (21-3)1 +(4-1)
3QS65
PITCH RATE 2 TO FDAI NO. 2 DISABLE (21-3)+(4-2)
A5K3
FDAI NO. 1 & NO. 2 PITCH RATE ENABLE (21-3)
A5K4
FDAI RATE & ERROR SOURCE SELECT (4-2)
1QS75
FDAI NO. 1 50° ERROR SF DISABLE [(3-1)[(5-1)+(4-3)]1
1QS76
FDAI NO. 2 50° ERROR SF DISABLE [(3-1)(5-1)(4-2)]1
3-1
3-2
GP1
51-1
X
4-1
5-3
4-3
2-1
4-2
5-2
5-1
6-2
6-1
ROLL
YAW
PITCH
A8K1
A8K3
A8K9
A8K11
A8K5
A8K7
IMU TO FDAI NO. 2 AND GDC TO FDAI NO. 1 ENABLE (4-2)[(5-1)+(5-3)(6-2)]+(4-1)[(5-2)+(5-3)(6-1)]
RESOLVER EXCITATION (4-1)[(5-2)+(5-3)(6-1)](7S5-3)
A4K3
FDAI NO. 1 ATTITUDE ENABLE (4-1)[(5-2)+(5-3)(6-1)]
1QS53 ROLL
2QS53 YAW
3QS53 PITCH
FDAI NO. 1 ATTITUDE GAIN DISABLE [(4-1)[(5-2)+(5-3)(6-1)]1
1QS53
2QS53
3QS53
1QS54 ROLL
2QS54 PITCH
3QS54 YAW
FDAI NO. 2 ATTITUDE GAIN DISABLE [(4-2)[(5-2)+(5-3)(6-1)]+(4-3)]1
1QS54
2QS54
3QS54
A4K1
FDAI NO. 2 ATTITUDE ENABLE (4-2)[(5-2)+(5-3)(6-1)]+(4-3)
A4K4
FDAI NO. 2 ATTITUDE MOTOR ENABLE (2-1)[(4-2)+(4-3)]
A4K2
FDAI NO. 1 ATTITUDE MOTOR ENABLE (2-1)[(4-1)+(4-3)]
28 VDC A

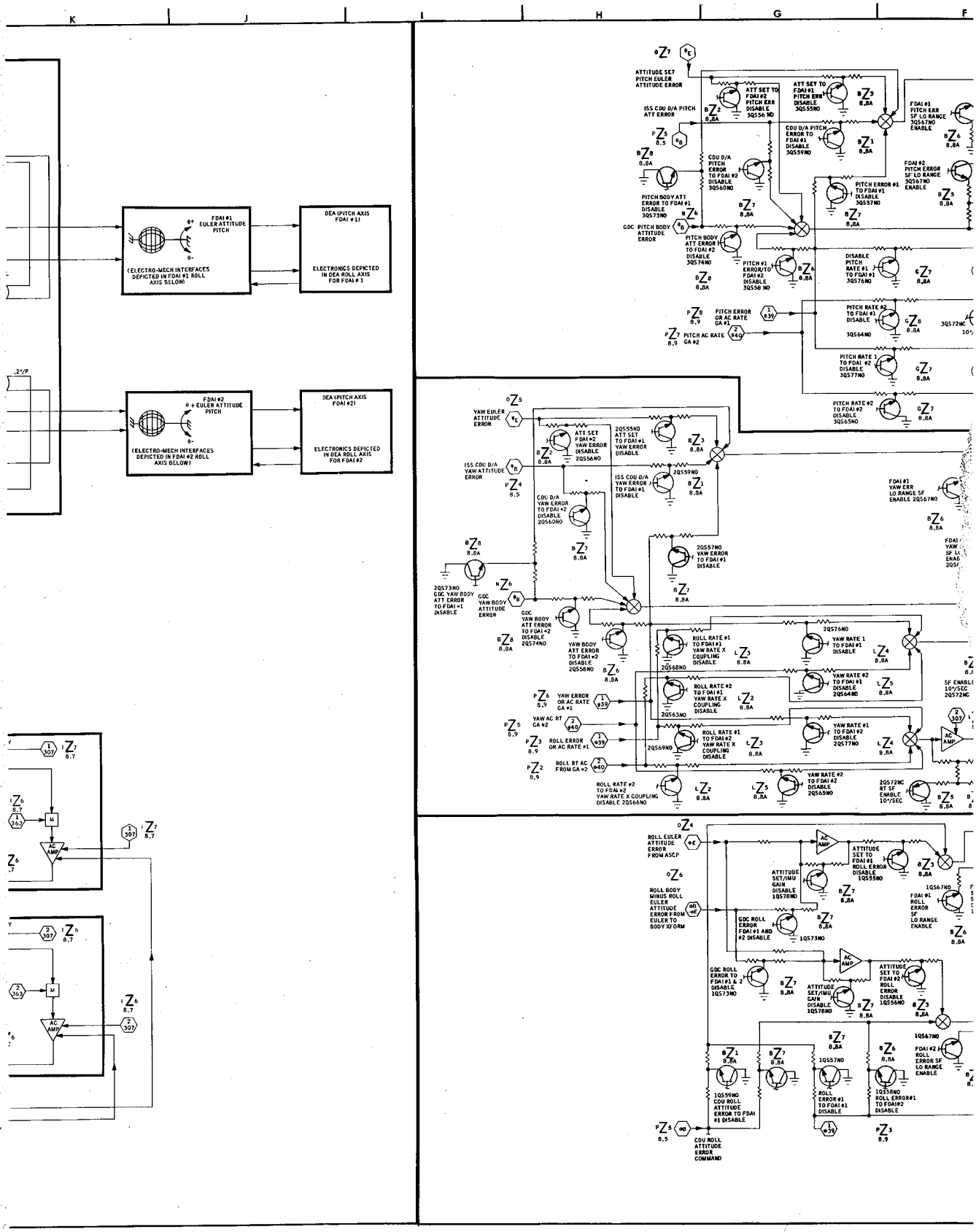

B
A
2QS74 YAW
3QS74 PITCH
GDC YAW, PITCH BODY ATTITUDE
ERROR TO FDAI NO. 2 DISABLE
(5-1) + (5-2) + (4-1) + (4-3) + (6-2)
YAW, PITCH
GDC ERROR TO FDAI NO. 1 DISABLE
(5-1) + (5-2) + (4-2) + (4-3) + (6-2)
3QS73
2QS73
1QS73
GDC ROLL ERROR TO FDAI NO. 1 AND 2 DISABLE
(5-1) + (5-2) + (4-3) + (6-2)
ROLL, YAW,PITCH
ERROR TO FDAI NO. 2 DISABLE, CDU
(5-2) + (5-3) + (4-1) + (4-3)
1QS60 2QS60 3QS60
1QS78
ATTITUDE SET/IMU GAIN DISABLE
(5-1) + (5-2) + (6-1)
ROLL, PITCH, YAW
ERROR NO. 1 TO FDAI NO. 1 DISABLE
(5-1) + (5-3) + (4-2) + (4-3) + GP1
1QS57 2QS57 3QS57
ROLL, PITCH, YAW
ERROR NO. 1 TO FDAI NO. 2 DISABLE
(5-1)1 (5-2)1 + (5-1)1 (4-2)1 +
(5-2)1 (4-3)1 + (4-2)1 (4-3)1 + (GP)1
1QS58 2QS58 3QS58
A9K1
FDAI NO. 1 ERROR ENABLE
(4-1) [(5-2) + (5-3)(6-1)]
A 315
ERROR SCALE FACTOR
LO RANGE ENABLE
FDAI NO. 1 (3-1)1
1QS67 2QS67 3QS67
ERROR SCALE FACTOR
LO RANGE ENABLE
FDAI NO. 2 (3-1)1
1QS67 2QS67 3QS67
RATE SCALE FACTOR ENABLE 10°/50° (3-1)
1QS72 2QS72 3QS72
FDAI 1
FDAI 2
RATE SCALE FACTOR ENABLE 5° OR 10°/50°
(3-1) + (3-2)
1QS71 2QS71 3QS71
FDAI 1
FDAI 2
A8K13R
IMU TO ATTITUDE SET ENABLE
(6-2)
A8K17P
A8K15Y
1QS55
ATTITUDE SET TO FDAI NO. 1 ERROR DISABLE ROLL
(4-2) + (4-3) + (2-1)1 + (5-2) + (5-1)
1QS56
ATTITUDE SET TO FDAI NO. 2 ROLL ERROR DISABLE
(4-1) + (4-3) + (2-1)1 + (5-2) + (5-1)
ATTITUDE SET TO FDAI NO. 1 YAW & PITCH ERROR DISABLE
(6-2)1 + (2-1)1 + (5-3)1 + (4-1)1
2QS55 3QS55
ATTITUDE SET TO FDAI NO. 2 YAW & PITCH ERROR
DISABLE (5-3)1 + (6-2)1 + (4-2)1 + (2-1)1
2QS56 3QS56
A9K2
TO FDAI NO. 2
ERROR ENABLE
(5-2) + (4-3)
B 315
A9K4
TO FDAI NO. 2
ERROR ENABLE
(5-3)(4-2)(6-1)
CDU ERROR TO FDAI NO. 1 DISABLE
[(4-3) + (5-1)(4-1)]1
1QS59 2QS59 3QS59

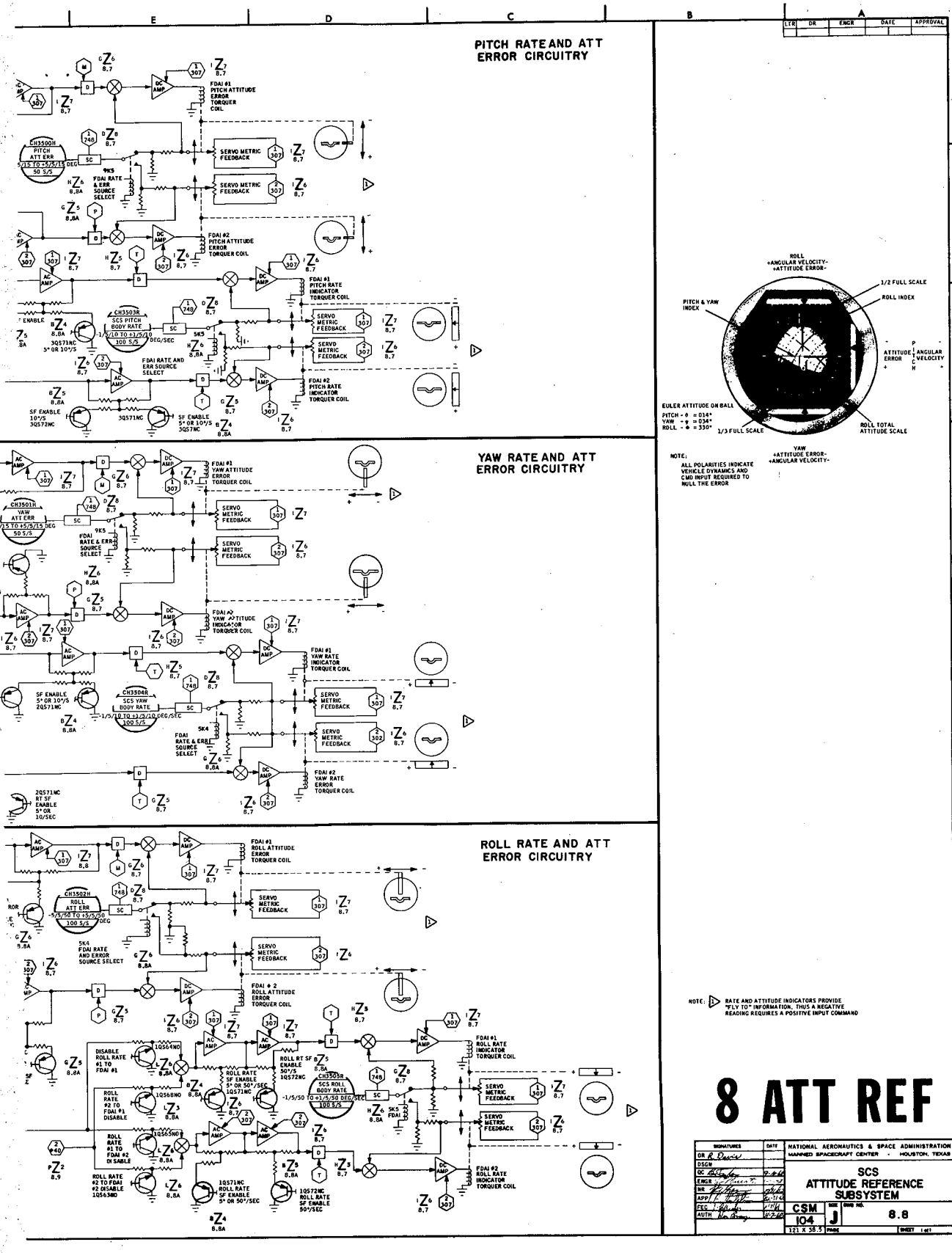
SECTION 8

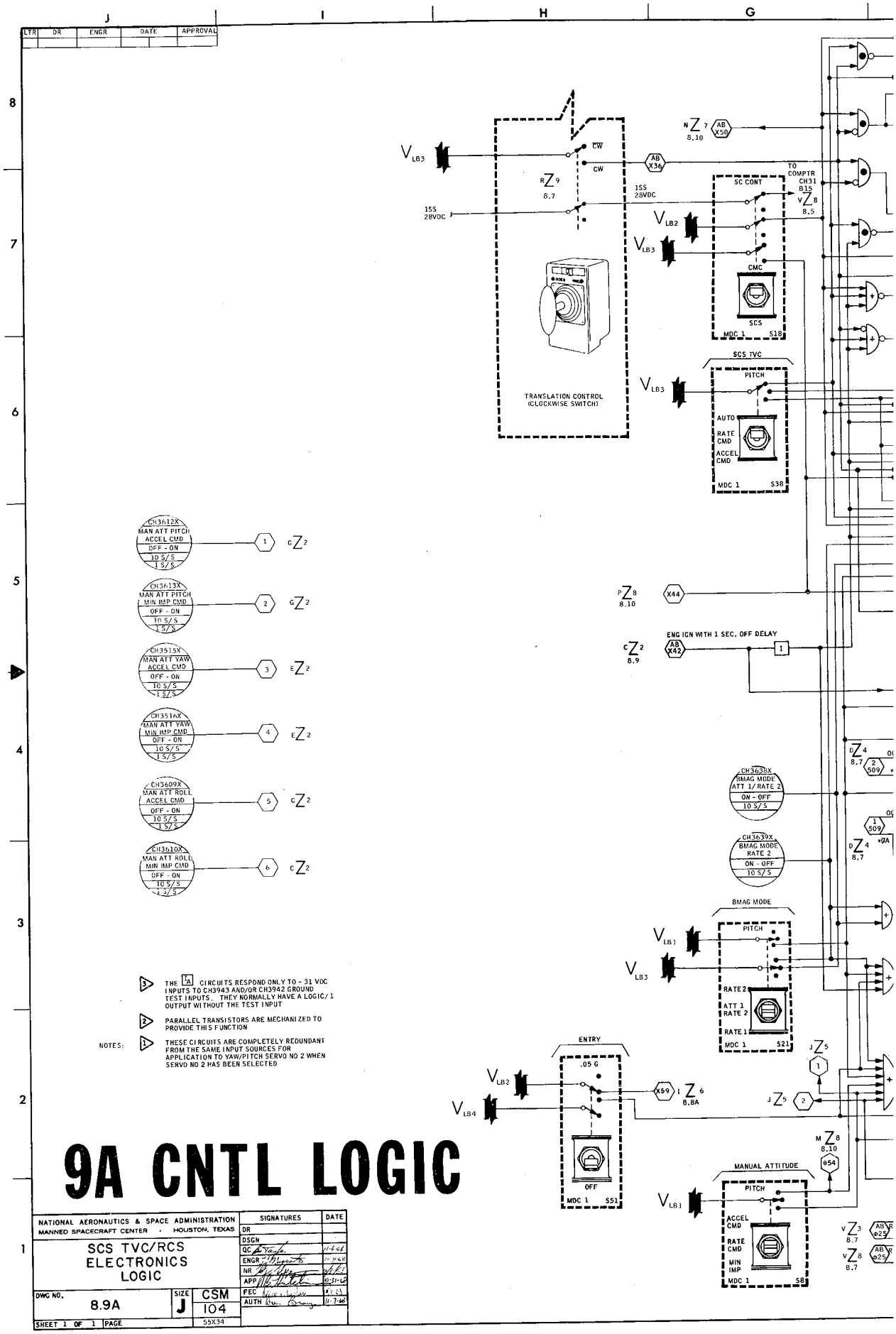
	IS	WAS
1. DWG 8.8A J Z 5	V LB4	V LB2
2. DWG 8.8A J Z 5	V LB2	V LB4
3. DWG 8.8A K Z 4	V LB2	V LB4
4. DWG 8.8A K Z 4	V LB4	V LB2


V
U
T
S
R
9
8
7
6
5
4
3
2
1
DC RATE NO 2
DC RATE NO 1
PITCH
A2K4 PITCH RATE 1 ENABLE
A2K2 PITCH .05G CONFIGURATION
A2K3 PITCH ALIGN ENABLE
A2K1 PITCH EULER MODE ENABLE
±20 VDC
q COS φE - r SIN φE
q SIN φE + r COS φE
SECANT AMP
1/COS φE
BODY RATE TO EULER RATE
A9K3 SECANT FUNCTION ENABLE
BODY RATE TO EULER RATE XFORMATION
(q COS φE - r SIN φE)(- SIN φE)/COS φE
q COS φE + r SIN φE/COS φE
RESET
LEV DET
CHOPPER
20 P/°/S
10P/°/S
5P/°/S
PITCH FREQ DIVIDER
PITCH STEPPER MOTOR DRIVE LOGIC
45°
CMC COUPLING LOGIC
+θ
-θ
TO CMC
EMS ROLL "ON" A6K2
25 P/°/S
RSI STEPPER MOTOR DRIVE LOGIC
YAW
A4K4 YAW RATE 1 ENABLE
YAW EULER MODE ENABLE A4K1
A4K3 YAW ALIGN ENABLE
A4K2 YAW .05G CONFIG
20 PPS/°/S
5 P/°/S
10 P/°/S
YAW FREQ DIVIDER
YAW STEPPER MOTOR DRIVE LOGIC
45°/PULSE
STEPPER MOTOR
YAW .05q CONFIGURATION
A6K1
ROLL
A3K4 ROLL RATE 1 ENABLE
A3K2 ROLL .05G CONFIG
A3K3 ROLL ALIGN ENABLE
A3K1 ROLL EULER MODE ENABLE
ROLL FREQ DIVIDER
ROLL STEPPER MOTOR DRIVE LOGIC


Q
P
O
N
M
L
FDAI
ORDEAL SCS INTERFACE
ORBITAL RATE
INERTIAL
ORDEAL
ORBITAL RATE CMD
FAST SLEW CMD
SLOW SLEW CMD
IMU TO FDAI #2 GDC TO FDAI #1 PITCH ENABLE
IMU TO FDAI #2 GDC TO FDAI #1 PITCH ENABLE
IMU TO FDAI #2 GDC TO FDAI #1 YAW ENABLE
GDC EULER PITCH RESOLVER
PITCH MANUAL ATT SET
PITCH
PITCH EULER ATTITUDE SET ERROR
ATTITUDE SET INPUT ENABLE
IMU TO ATT SET PITCH ENABLE
EMS LIFT VECTOR INDICATOR
SM
0.4°/PULSE
ΦE IMU INNER GIMBAL RESOLVER
25 V 800 CPS
EULER ATTITUDE TO BODY AXES ATTITUDE ERROR CONVERSION
YAW BODY ATT SET ERROR
PITCH BODY ATT SET ERROR
ROLL BODY MINUS ROLL EULER ATTITUDE ERROR
GDC EULER YAW RESOLVER
YAW MANUAL ATT SET
YAW
YAW EULER ATTITUDE SET ERROR
IMU TO ATT SET YAW ENABLE
ATT SET INPUT ENABLE
ΦE IMU MIDDLE GIMBAL RESOLVER
FDAI #1 EULER ATTITUDE YAW
FDAI #2 EULER ATTITUDE YAW
(ELECTRO-MECH INTERFACES DEPICTED IN FDAI #2 ROLL AXIS BELOW)
DEA (YAW AXIS FDAI #1)
DEA (YAW AXIS FDAI #2)
ELECTRONICS DEPICT
IN DEA ROLL AXIS FD
FDAI #1)
FDAI #2)
IMU TO FDAI #2 GDC TO FDAI #1 YAW ENABLE
ROLL EULER ATTITUDE SET ERROR
GDC EULER ROLL RESOLVER
ROLL MANUAL ATTITUDE SET
ROLL
IMU TO ATT SET ROLL ENABLE
ΦE IMU OUTER GIMBAL
25 VAC 800 CPS
IMU TO FDAI #2 GDC TO FDAI #1 ROLL ENABLE
FDAI #1 EULER ATTITUDE ROLL
FDAI #2 EULER ATTITUDE ROLL
ROLL INDEX
VG
M
FDAI NO 1 ATT MOTOR ENABLE
FDAI NO 2 ATT MOTOR ENABLE
IMU TO FDAI #2 & GDC TO FDAI #1 ROLL ENABLE
ATTITUDE SET INPUT ENABLE
ATTITUDE GAIN DISABLE FDAI #1
ATTITUDE GAIN DISABLE FDAI #2
1Q553NC
1Q554NC
DISPLAY ELECTRONIC
(ROLL AXIS FDA
OUT Φ

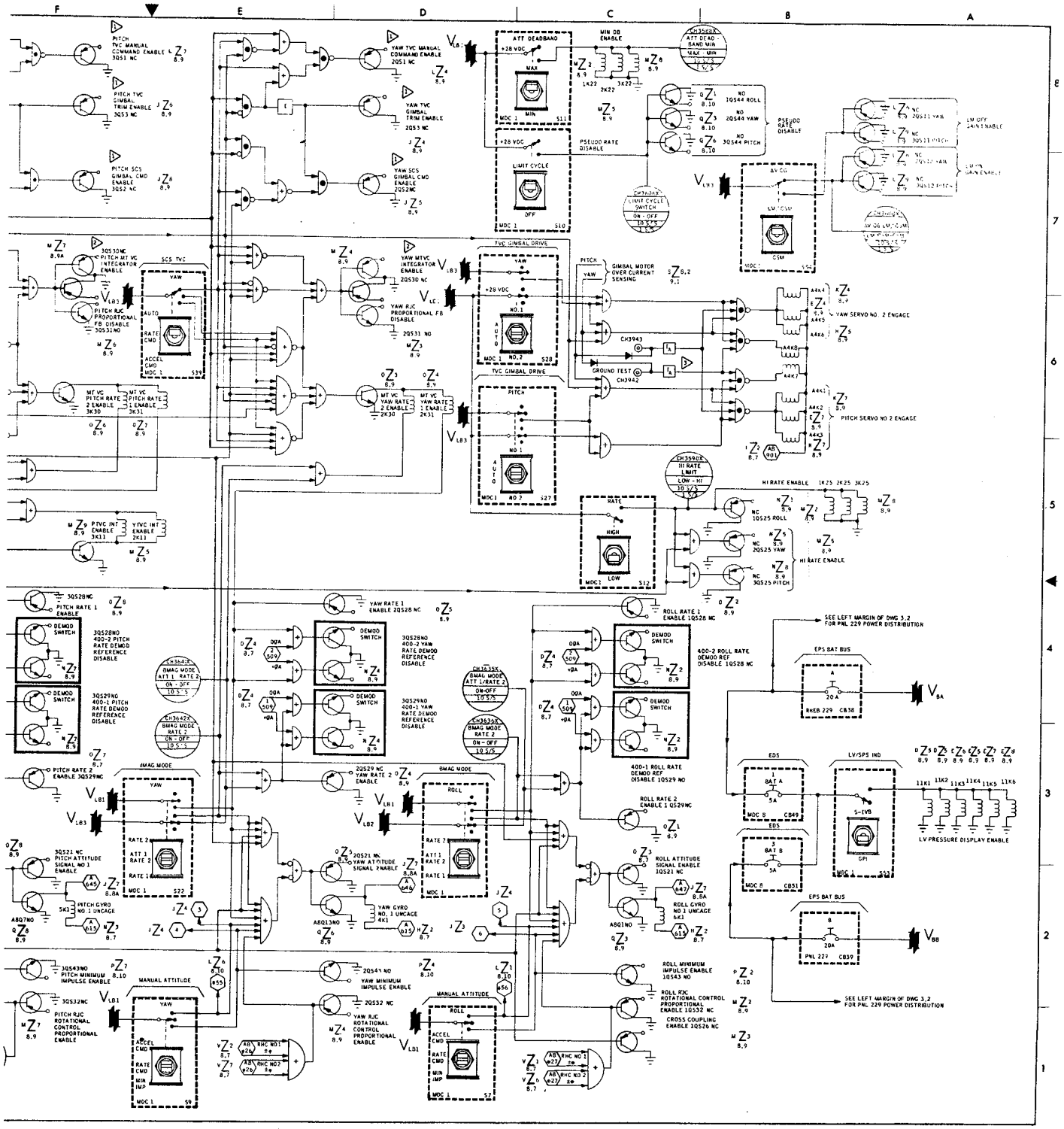

K
J
I
H
G
F
FDAI #1 EULER ATTITUDE PITCH
(ELECTRO-MECH INTERFACES DEPICTED IN FDAI #1 ROLL AXIS BELOW)
DEA (PITCH AXIS FDAI #1)
ELECTRONICS DEPICTED IN DEA ROLL AXIS FOR FDAI # 1
FDAI #2 θ + EULER ATTITUDE PITCH
(ELECTRO-MECH INTERFACES DEPICTED IN FDAI #2 ROLL AXIS BELOW)
DEA (PITCH AXIS FDAI #2)
ELECTRONICS DEPICTED IN DEA ROLL AXIS FOR FDAI #2
ATTITUDE SET PITCH EULER ATTITUDE ERROR
ISS CDU D/A PITCH ATT ERROR
GDC PITCH BODY ATTITUDE ERROR
PITCH AC RATE GA #2
YAW EULER ATTITUDE ERROR
ISS CDU D/A YAW ATTITUDE ERROR
GDC YAW BODY ATTITUDE ERROR
ROLL EULER ATTITUDE ERROR FROM ASCP
ROLL BODY MINUS ROLL EULER ATTITUDE ERROR FROM EULER TO BODY XFORM
CDU ROLL ATTITUDE ERROR COMMAND
AC AMP


PITCH RATE AND ATT ERROR CIRCUITRY
FDAI #1 PITCH ATTITUDE ERROR TORQUER COIL
CH3506H PITCH ATT ERR -5/15 TO +5/5/15 DEG 50 S/S
SERVO METRIC FEEDBACK
FDAI RATE & ERR SOURCE SELECT
FDAI #2 PITCH ATTITUDE ERROR TORQUER COIL
FDAI #1 PITCH RATE INDICATOR TORQUER COIL
CH3503R SCS PITCH BODY RATE -1/5/10 TO +1/5/10 DEG/SEC 100 S/S
FDAI RATE AND ERR SOURCE SELECT
FDAI #2 PITCH RATE INDICATOR TORQUER COIL
SF ENABLE 10°/S 3Q572NC
3Q571NC
SF ENABLE 5° OR 10°/S 3Q571NC
YAW RATE AND ATT ERROR CIRCUITRY
FDAI #1 YAW ATTITUDE ERROR TORQUER COIL
CH3501H YAW ATT ERR -5/15 TO +5/5/15 DEG 50 S/S
FDAI RATE & ERR SOURCE SELECT
FDAI YAW ATTITUDE INDICATOR TORQUER COIL
FDAI #1 YAW RATE INDICATOR TORQUER COIL
SF ENABLE 5° OR 10°/S 2Q571NC
CH3504R SCS YAW BODY RATE -1/5/10 TO +1/5/10 DEG/SEC 100 S/S
FDAI RATE & ERR SOURCE SELECT
FDAI #2 YAW RATE ERROR TORQUER COIL
2Q571NC RT SF ENABLE 5° OR 10/SEC
ROLL RATE AND ATT ERROR CIRCUITRY
FDAI #1 ROLL ATTITUDE ERROR TORQUER COIL
CH3502H ROLL ATT ERR -5/5/50 TO +5/5/50 100 S/S DEG
5K4 FDAI RATE AND ERROR SOURCE SELECT
FDAI # 2 ROLL ATTITUDE ERROR TORQUER COIL
DISABLE ROLL RATE #1 TO FDAI #1
1Q564NO
ROLL RATE SF ENABLE 5° OR 50°/SEC 1Q571NC
ROLL RT SF ENABLE 50°/S 1Q572NC
CH3505R SCS ROLL BODY RATE -1/5/50 TO +1/5/50 DEG/SEC 100 S/S
FDAI #1 ROLL RATE INDICATOR TORQUER COIL
ROLL RATE #2 TO FDAI #1 DISABLE
1Q566NO
5K5 FDAI
ROLL RATE #1 TO FDAI #2 DISABLE
1Q565NO
ROLL RATE #2 TO FDAI #2 DISABLE 1Q565NO
1Q571NC ROLL RATE SF ENABLE 5° OR 50°/SEC
1Q572NC ROLL RATE SF ENABLE 50°/SEC
FDAI #2 ROLL RATE INDICATOR TORQUER COIL
ROLL +ANGULAR VELOCITY- +ATTITUDE ERROR-
1/2 FULL SCALE
ROLL INDEX
PITCH & YAW INDEX
ATTITUDE ERROR
ANGULAR VELOCITY
EULER ATTITUDE ON BALL
PITCH - Φ = 014°
YAW - Φ = 034°
ROLL - Φ = 330°
1/3 FULL SCALE
ROLL TOTAL ATTITUDE SCALE
YAW +ATTITUDE ERROR- +ANGULAR VELOCITY-
NOTE: ALL POLARITIES INDICATE VEHICLE DYNAMICS AND CMD INPUT REQUIRED TO NULL THE ERROR
NOTE: RATE AND ATTITUDE INDICATORS PROVIDE "FLY TO" INFORMATION. THUS A NEGATIVE READING REQUIRES A POSITIVE INPUT COMMAND
8 ATT REF
NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER - HOUSTON, TEXAS
SCS ATTITUDE REFERENCE SUBSYSTEM
CSM 104
SIZE J
DWG NO. 8.8
121 X 58.5
SHEET 1 of 1



9A CNTL LOGIC

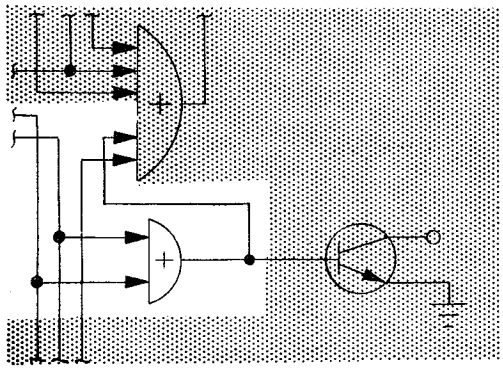
NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER · HOUSTON, TEXAS		SIGNATURES	DATE
SCS TVC/RCS ELECTRONICS LOGIC		DR	
		DSGN	
		QC	11-6-68
		ENGR	11-6-68
		NR	11-6-68
		APP	10-31-68
		FEC	11-6-68
		AUTH	11-7-68
DWG NO. 8.9A	SIZE J	CSM 104	
SHEET 1 OF 1	PAGE	55X34	


F
E
D
C
B
A
8
7
6
5
4
3
2
1
PITCH TVC MANUAL COMMAND ENABLE 3QS1 NC
PITCH TVC GIMBAL TRIM ENABLE 3QS3 NC
PITCH SCS GIMBAL CMD ENABLE 3QS2 NC
YAW TVC MANUAL COMMAND ENABLE 2QS1 NC
YAW TVC GIMBAL TRIM ENABLE 2QS3 NC
YAW SCS GIMBAL CMD ENABLE 2QS2 NC
ATT DEADBAND
+28 VDC
MAX
MIN
MDC 1 S11
LIMIT CYCLE
OFF
MDC 1 S10
MIN DB ENABLE
ATT DEAD - BAND MIN MAX - MIN
PSEUDO RATE DISABLE
NO 1QS44 ROLL
NO 2QS44 YAW
NO 3QS44 PITCH
LIMIT CYCLE SWITCH ON - OFF
SM OFF GAIN ENABLE
LM ON GAIN ENABLE
SCS TVC
YAW
AUTO
RATE CMD
ACCEL CMD
MDC 1 S39
3QS30NC PITCH MT VC INTEGRATOR ENABLE
PITCH RJC PROPORTIONAL FB DISABLE 3QS31NO
MT VC PITCH RATE 2 ENABLE 3K30
MT VC PITCH RATE 1 ENABLE 3K31
YAW MTVC INTEGRATOR ENABLE 2QS30 NC
YAW RJC PROPORTIONAL FB DISABLE 2QS31 NO
MT VC YAW RATE 2 ENABLE 2K30
MT VC YAW RATE 1 ENABLE 2K31
P/TVC INT ENABLE 2K11
Y/TVC INT ENABLE 2K11
TVC GIMBAL DRIVE
YAW
+28 VDC
NO 1
NO 2
MDC 1 S28
PITCH
MDC 1 S27
GIMBAL MOTOR OVER CURRENT SENSING
CH3943
GROUND TEST
CH3942
YAW SERVO NO. 2 ENGAGE
PITCH SERVO NO 2 ENGAGE
CH3590X HI RATE LIMIT LOW - HI
HI RATE ENABLE 1K25 2K25 3K25
RATE
HIGH
LOW
MDC 1 S12
NC 1QS25 ROLL
NC 2QS25 YAW
NC 3QS25 PITCH
HI RATE ENABLE
3QS28NO PITCH RATE 1 ENABLE
3QS28NO 400-2 PITCH RATE DEMOD REFERENCE DISABLE
3QS29NO 400-1 PITCH RATE DEMOD REFERENCE DISABLE
CH3642X BMAG MODE ATT 1 RATE 2 ON - OFF
CH3643X BMAG MODE RATE 2 ON - OFF
YAW RATE 1 ENABLE 2QS28 NC
3QS28NO 400-2 YAW RATE DEMOD REFERENCE DISABLE
3QS29NO 400-1 YAW RATE DEMOD REFERENCE DISABLE
CH3635X BMAG MODE ATT 1/RATE 2 ON-OFF
CH3636X BMAG MODE RATE 2 ON - OFF
ROLL RATE 1 ENABLE 1QS28 NC
400-2 ROLL RATE DEMOD REF DISABLE 1QS28 NC
400-1 ROLL RATE DEMOD REF DISABLE 1QS29 NO
ROLL RATE 2 ENABLE 1 QS29NC
SEE LEFT MARGIN OF DWG 3.2 FOR PNL 229 POWER DISTRIBUTION
EPS BAT BUS
RHEB 229 CB36
EDS
MDC 8 CB49
MDC 8 CB51
LV/SPS IND
S-IVB
GPI
MDC 1 S43
LV PRESSURE DISPLAY ENABLE
PITCH RATE 1 ENABLE
PITCH RATE 2 ENABLE 3QS29NC
BMAG MODE
YAW
ROLL
ATT 1 RATE 2
RATE 2
RATE 1
MDC 1 S72
3QS21 NC PITCH ATTITUDE SIGNAL NO 1 ENABLE
PITCH GYRO NO. 1 UNCAGE
2QS21 NC YAW ATTITUDE SIGNAL ENABLE
YAW GYRO NO. 1 UNCAGE
ROLL ATTITUDE SIGNAL ENABLE 1QS21 NC
ROLL GYRO NO 1 UNCAGE
3QS43NO PITCH MINIMUM IMPULSE ENABLE
3QS32NC PITCH RJC ROTATIONAL CONTROL PROPORTIONAL ENABLE
MANUAL ATTITUDE
YAW
ACCEL CMD
RATE CMD
MIN IMP
MDC 1 S9
2QS43 NO YAW MINIMUM IMPULSE ENABLE
2QS32 NC YAW RJC ROTATIONAL CONTROL PROPORTIONAL ENABLE
ROLL
MDC 1 S7
ROLL MINIMUM IMPULSE ENABLE 1QS43 NO
ROLL RJC ROTATIONAL CONTROL PROPORTIONAL ENABLE 1QS32 NC
CROSS COUPLING ENABLE 1QS26 NC
A8 RHC NO 1
A8 RHC NO 2
SEE LEFT MARGIN OF DWG 3.2 FOR PNL 229 POWER DISTRIBUTION

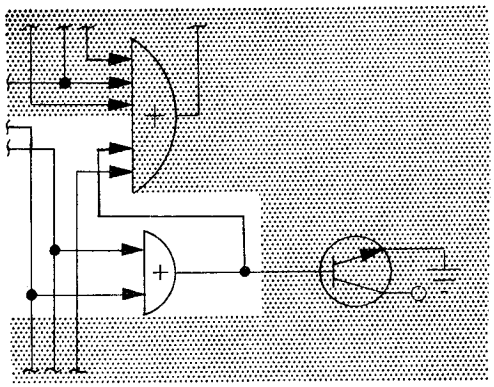
SECTION 8

IS

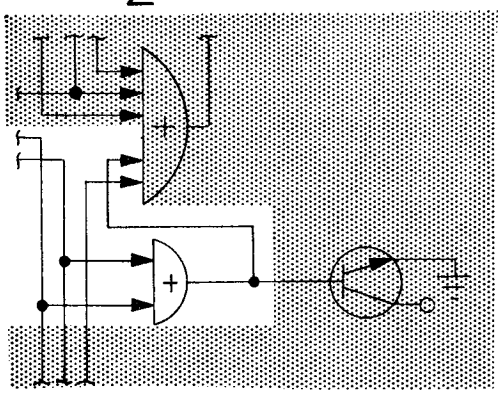
1. DWG 8.9A C Z2



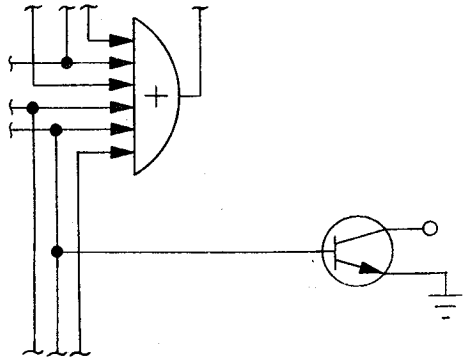
2. DWG 8.9A E Z2

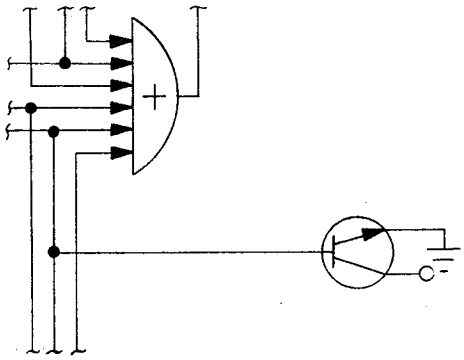


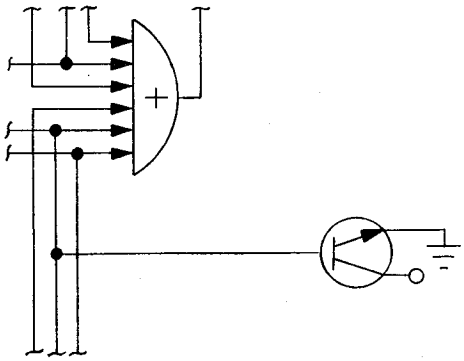
3. DWG 8.9A F Z2



WAS







SECTION 8

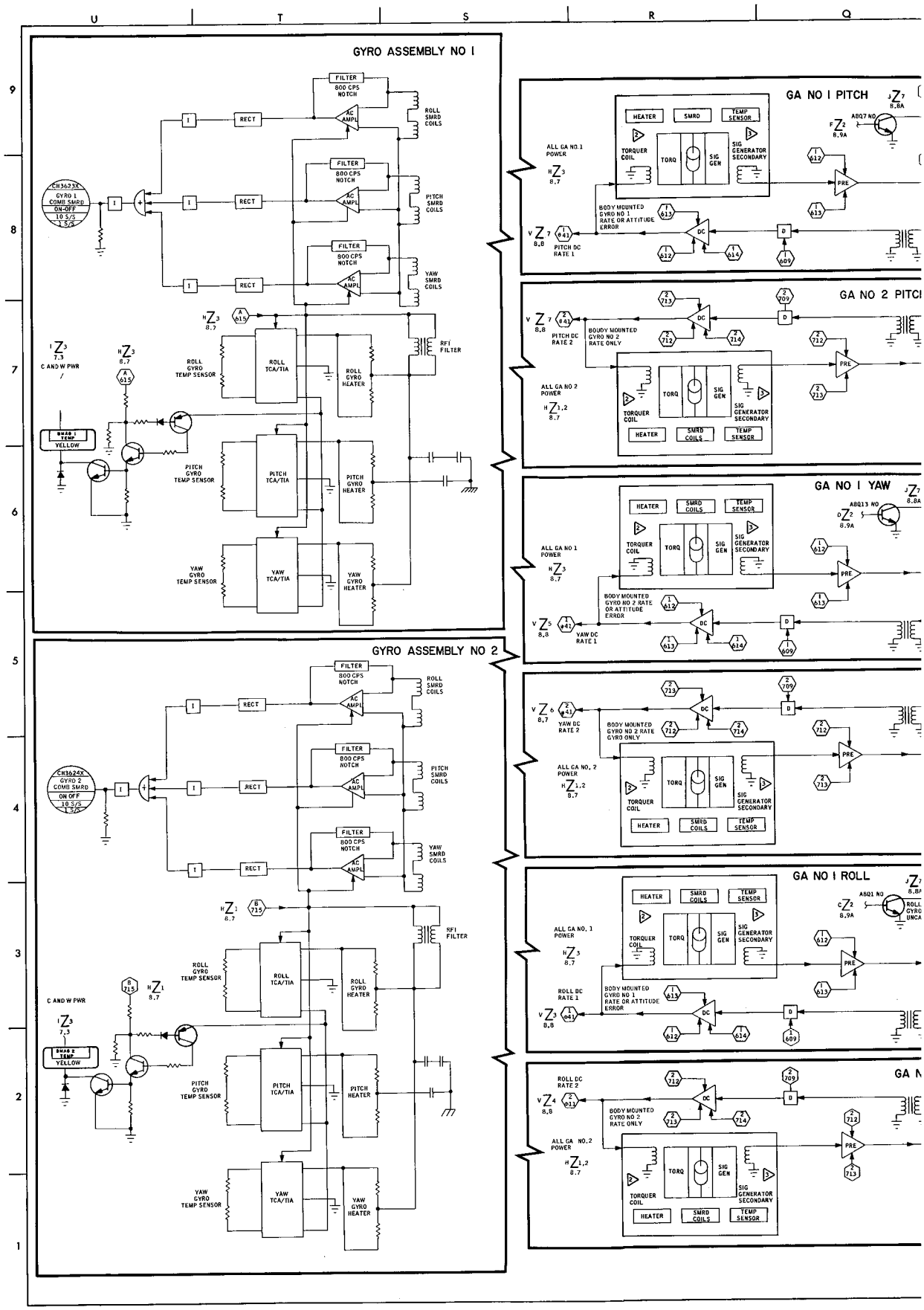
IS

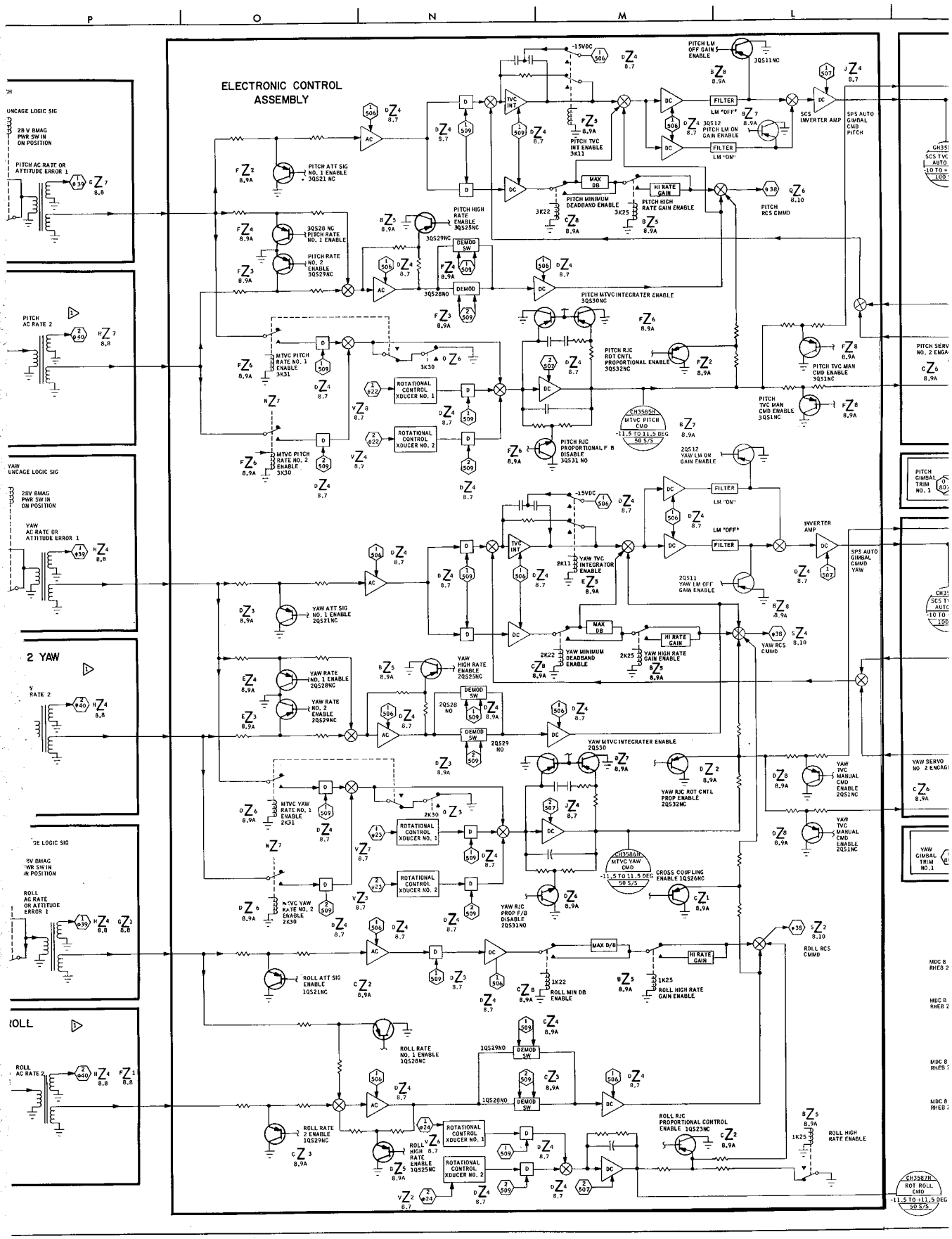
4. DWG 8.9A H Z8

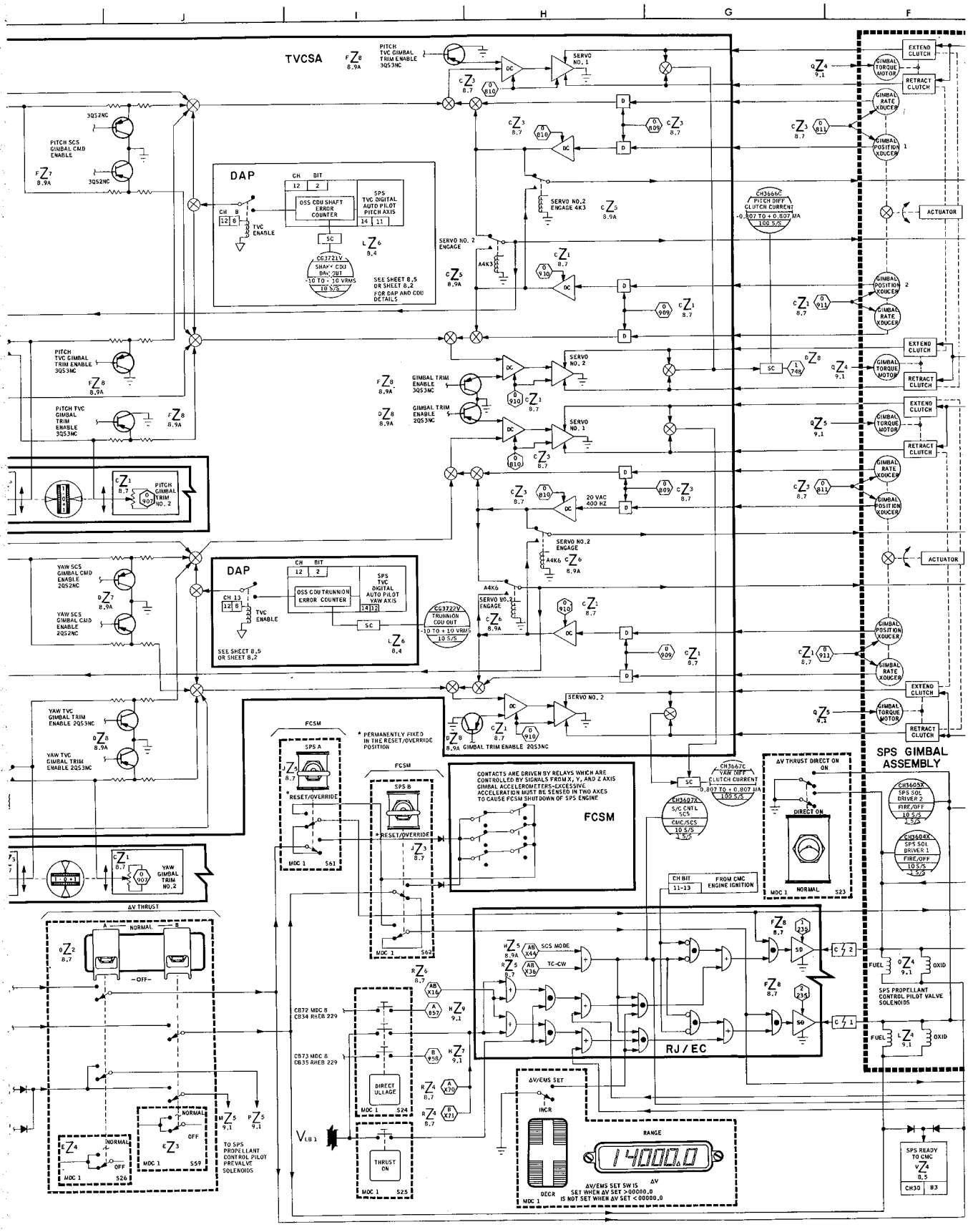
V_{LB2}

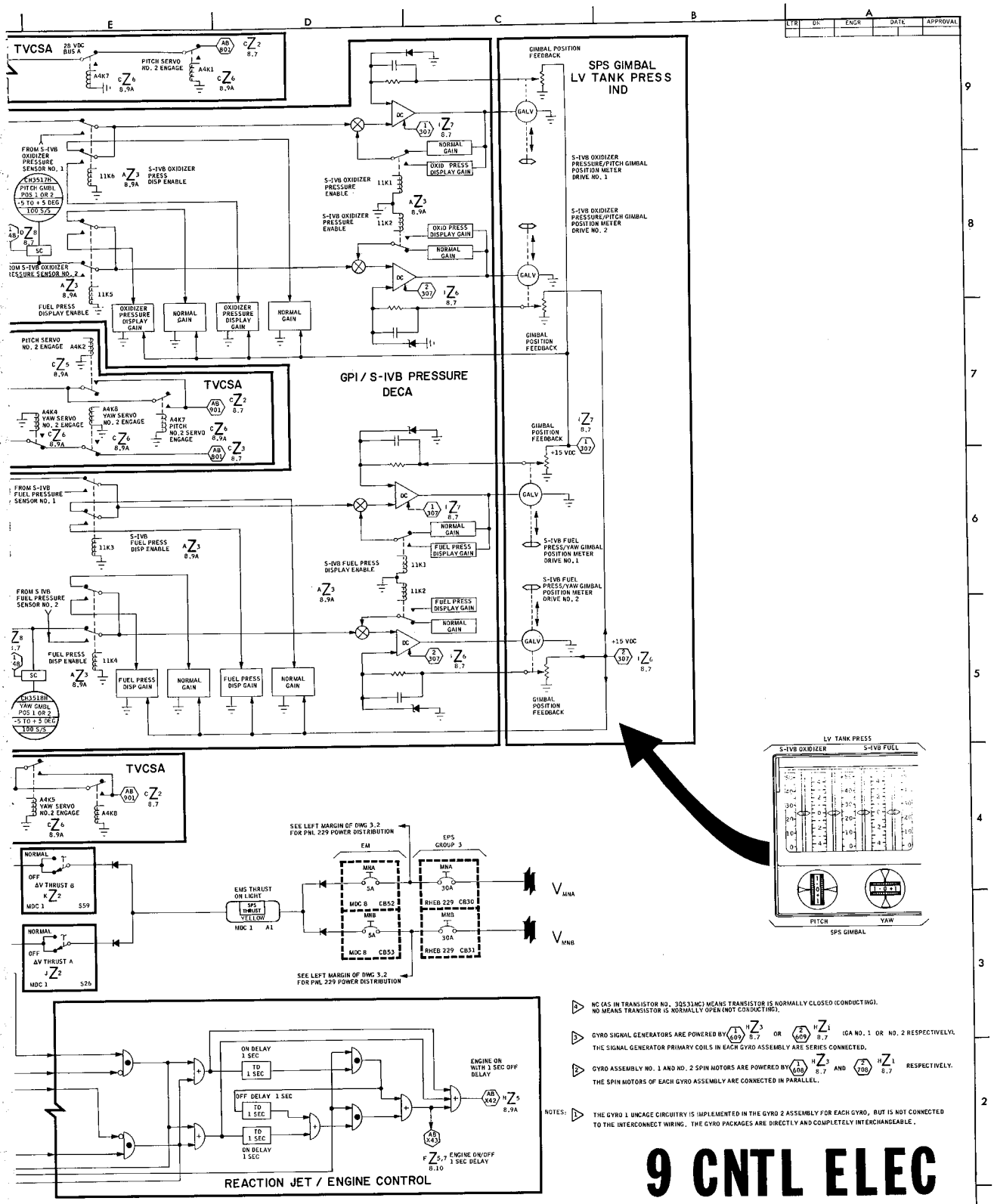
WAS

V_{LB3}


GYRO ASSEMBLY NO 1
GYRO ASSEMBLY NO 2
FILTER 800 CPS NOTCH
AC AMPL
RECT
ROLL SMRD COILS
PITCH SMRD COILS
YAW SMRD COILS
CH3623X GYRO 1 COMB SMRD ON-OFF 10 S/S 1 S/S
CH3624X GYRO 2 COMB SMRD ON OFF 10 S/S 1 S/S
ROLL GYRO TEMP SENSOR
ROLL TCA/TIA
ROLL GYRO HEATER
PITCH GYRO TEMP SENSOR
PITCH TCA/TIA
PITCH GYRO HEATER
YAW GYRO TEMP SENSOR
YAW TCA/TIA
YAW GYRO HEATER
RFI FILTER
C AND W PWR
SMAB 1 TEMP YELLOW
SMAB 2 TEMP YELLOW
GA NO 1 PITCH
GA NO 2 PITCH
GA NO 1 YAW
GA NO 1 ROLL
HEATER
SMRD COILS
TEMP SENSOR
TORQUER COIL
TORQ
SIG GEN
SIG GENERATOR SECONDARY
ALL GA NO 1 POWER
ALL GA NO 2 POWER
BODY MOUNTED GYRO NO 1 RATE OR ATTITUDE ERROR
BODY MOUNTED GYRO NO 2 RATE ONLY
PITCH DC RATE 1
PITCH DC RATE 2
YAW DC RATE 1
YAW DC RATE 2
ROLL DC RATE 1
ROLL DC RATE 2
DC
PRE


P
O
N
M
L
ELECTRONIC CONTROL ASSEMBLY
-15VDC
PITCH LM OFF GAIN ENABLE
3QS11NC
TVC INT
FILTER
LM "OFF"
LM "ON"
SCS INVERTER AMP
SPS AUTO GIMBAL CMD PITCH
3QS12 PITCH LM ON GAIN ENABLE
PITCH TVC INT ENABLE 3K11
MAX DB
HI RATE GAIN
PITCH MINIMUM DEADBAND ENABLE
PITCH HIGH RATE GAIN ENABLE
PITCH RCS CMMD
PITCH ATT SIG NO. 1 ENABLE + 3QS21 NC
PITCH HIGH RATE ENABLE 3QS25NC
3QS29NC
DEMOD SW
3QS28NO
3QS28 NC PITCH RATE NO. 1 ENABLE
PITCH RATE NO. 2 ENABLE 3QS29NC
PITCH MTVC INTEGRATER ENABLE 3QS30NC
PITCH RJC ROT CNTL PROPORTIONAL ENABLE 3QS32NC
PITCH TVC MAN CMD ENABLE 3QS1NC
MTVC PITCH RATE NO. 1 ENABLE 3K31
MTVC PITCH RATE NO. 2 ENABLE 3K30
ROTATIONAL CONTROL XDUCER NO. 1
ROTATIONAL CONTROL XDUCER NO. 2
CH3585H MTVC PITCH CMD -11.5 TO 11.5 DEG 50 S/S
PITCH RJC PROPORTIONAL F B DISABLE 3QS31 NO
2QS12 YAW LM ON GAIN ENABLE
YAW TVC INTEGRATOR ENABLE 2K11
2QS11 YAW LM OFF GAIN ENABLE
INVERTER AMP
SPS AUTO GIMBAL CMMD YAW
YAW ATT SIG NO. 1 ENABLE 2QS21NC
YAW MINIMUM DEADBAND ENABLE 2K22
YAW HIGH RATE GAIN ENABLE 2K25
YAW RCS CMMD
YAW HIGH RATE ENABLE 2QS25NC
2QS28NO
2QS29NO
YAW RATE NO. 1 ENABLE 2QS28NC
YAW RATE NO. 2 ENABLE 2QS29NC
YAW MTVC INTEGRATER ENABLE 2QS30
YAW RJC ROT CNTL PROP ENABLE 2QS32NC
YAW TVC MANUAL CMD ENABLE 2QS1NC
MTVC YAW RATE NO. 1 ENABLE 2K31
TVC YAW RATE NO. 2 ENABLE 2K30
CH3586H MTVC YAW CMD -11.5 TO 11.5 DEG 50 S/S
CROSS COUPLING ENABLE 1QS26NC
YAW RJC PROP F/B DISABLE 2QS31NO
ROLL RCS CMMD
ROLL ATT SIG ENABLE 1QS21NC
1K22 ROLL MIN DB ENABLE
1K25 ROLL HIGH RATE GAIN ENABLE
ROLL RATE NO. 1 ENABLE 1QS28NC
1QS29NO
1QS28NO
ROLL RATE 2 ENABLE 1QS29NC
ROLL HIGH RATE ENABLE 1QS25NC
ROLL RJC PROPORTIONAL CONTROL ENABLE 1QS23NC
ROLL HIGH RATE ENABLE
CH3587H ROT ROLL CMD -11.5 TO +11.5 DEG 50 S/S
UNCAGE LOGIC SIG
28 V BMAG PWR SW IN ON POSITION
PITCH AC RATE OR ATTITUDE ERROR 1
PITCH AC RATE 2
YAW UNCAGE LOGIC SIG
YAW AC RATE OR ATTITUDE ERROR 1
2 YAW
ROLL AC RATE OR ATTITUDE ERROR 1
ROLL AC RATE 2
PITCH SERV NO. 2 ENGA
PITCH GIMBAL TRIM NO. 1
YAW SERVO NO. 2 ENGAG
YAW GIMBAL TRIM NO. 1
MDC 8 RHEB 2
MDC 8 RHEB 2
MDC 8 RHEB 2


TVCSA
PITCH TVC GIMBAL TRIM ENABLE 3QS3NC
SERVO NO. 1
EXTEND CLUTCH
GIMBAL TORQUE MOTOR
RETRACT CLUTCH
GIMBAL RATE XDUCER
GIMBAL POSITION XDUCER
3QS2NC
PITCH SCS GIMBAL CMD ENABLE
DAP
CH BIT
OSS CDU SHAFT ERROR COUNTER
SPS TVC DIGITAL AUTO PILOT PITCH AXIS
TVC ENABLE
CG3721V SHAFT CDU DAC OUT -10 TO +10 VRMS 10 S/S
SEE SHEET 8.5 OR SHEET 8.2
FOR DAP AND CDU DETAILS
SERVO NO. 2 ENGAGE 4K3
CH3666C PITCH DIFF CLUTCH CURRENT -0.807 TO +0.807 MA 100 S/S
ACTUATOR
SERVO NO. 2
PITCH TVC GIMBAL TRIM ENABLE 3QS3NC
GIMBAL TRIM ENABLE 3QS3NC
GIMBAL TRIM ENABLE 2QS3NC
PITCH GIMBAL TRIM NO. 2
YAW SCS GIMBAL CMD ENABLE 2QS2NC
OSS CDU TRUNNION ERROR COUNTER
SPS TVC DIGITAL AUTO PILOT YAW AXIS
CG3722V TRUNNION CDU OUT -10 TO +10 VRMS 10 S/S
SERVO NO.2 ENGAGE A4K6
20 VAC 400 HZ
YAW TVC GIMBAL TRIM ENABLE 2QS3NC
YAW GIMBAL TRIM NO. 2
FCSM
SPS A
SPS B
* RESET/OVERRIDE
* PERMANENTLY FIXED IN THE RESET/OVERRIDE POSITION
CONTACTS ARE DRIVEN BY RELAYS WHICH ARE CONTROLLED BY SIGNALS FROM X, Y, AND Z AXIS GIMBAL ACCELEROMETERS-EXCESSIVE ACCELERATION MUST BE SENSED IN TWO AXES TO CAUSE FCSM SHUTDOWN OF SPS ENGINE
FCSM
CH3667C YAW DIFF CLUTCH CURRENT -0.807 TO +0.807 MA 100 S/S
CH3607X S/C CNTL SCS CMC/SCS 10 S/S 2 S/S
ΔV THRUST DIRECT ON
DIRECT ON
NORMAL
SPS GIMBAL ASSEMBLY
CH3605X SPS SOL DRIVER 2 FIRE/OFF 10 S/S 2 S/S
CH3604X SPS SOL DRIVER 1 FIRE/OFF 10 S/S 2 S/S
CH BIT 11-13 FROM CMC ENGINE IGNITION
ΔV THRUST
A NORMAL B
-OFF-
SCS MODE
TC-CW
RJ/EC
FUEL
OXID
SPS PROPELLANT CONTROL PILOT VALVE SOLENOIDS
CB72 MDC 8 CB34 RHEB 229
CB73 MDC 8 CB35 RHEB 229
DIRECT ULLAGE
THRUST ON
TO SPS PROPELLANT CONTROL PILOT PREVALVE SOLENOIDS
ΔV/EMS SET
INCR
DECR
RANGE
140000.0
ΔV
ΔV/EMS SET SW IS SET WHEN ΔV SET >00000.0 IS NOT SET WHEN ΔV SET <00000.0
SPS READY TO CMC
CH30 B3



4 NC (AS IN TRANSISTOR NO. 3Q531NC) MEANS TRANSISTOR IS NORMALLY CLOSED (CONDUCTING). NO MEANS TRANSISTOR IS NORMALLY OPEN (NOT CONDUCTING).

3 GYRO SIGNAL GENERATORS ARE POWERED BY (1/609) $^{H}Z_{3}$ 8.7 OR (2/609) $^{H}Z_{1}$ 8.7 (GA NO. 1 OR NO. 2 RESPECTIVELY). THE SIGNAL GENERATOR PRIMARY COILS IN EACH GYRO ASSEMBLY ARE SERIES CONNECTED.

2 GYRO ASSEMBLY NO. 1 AND NO. 2 SPIN MOTORS ARE POWERED BY (1/608) $^{H}Z_{3}$ 8.7 AND (2/708) $^{H}Z_{1}$ 8.7 RESPECTIVELY. THE SPIN MOTORS OF EACH GYRO ASSEMBLY ARE CONNECTED IN PARALLEL.

NOTES: 1 THE GYRO 1 UNCAGE CIRCUITRY IS IMPLEMENTED IN THE GYRO 2 ASSEMBLY FOR EACH GYRO, BUT IS NOT CONNECTED TO THE INTERCONNECT WIRING. THE GYRO PACKAGES ARE DIRECTLY AND COMPLETELY INTERCHANGEABLE.

9 CNTL ELEC

SIGNATURES	DATE
DR	12/9/68
DSGN	
QC	9-6-68
ENGR	
NR	9-5-68
APP	9-13-68
FEC	
AUTH	10-7-68

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS

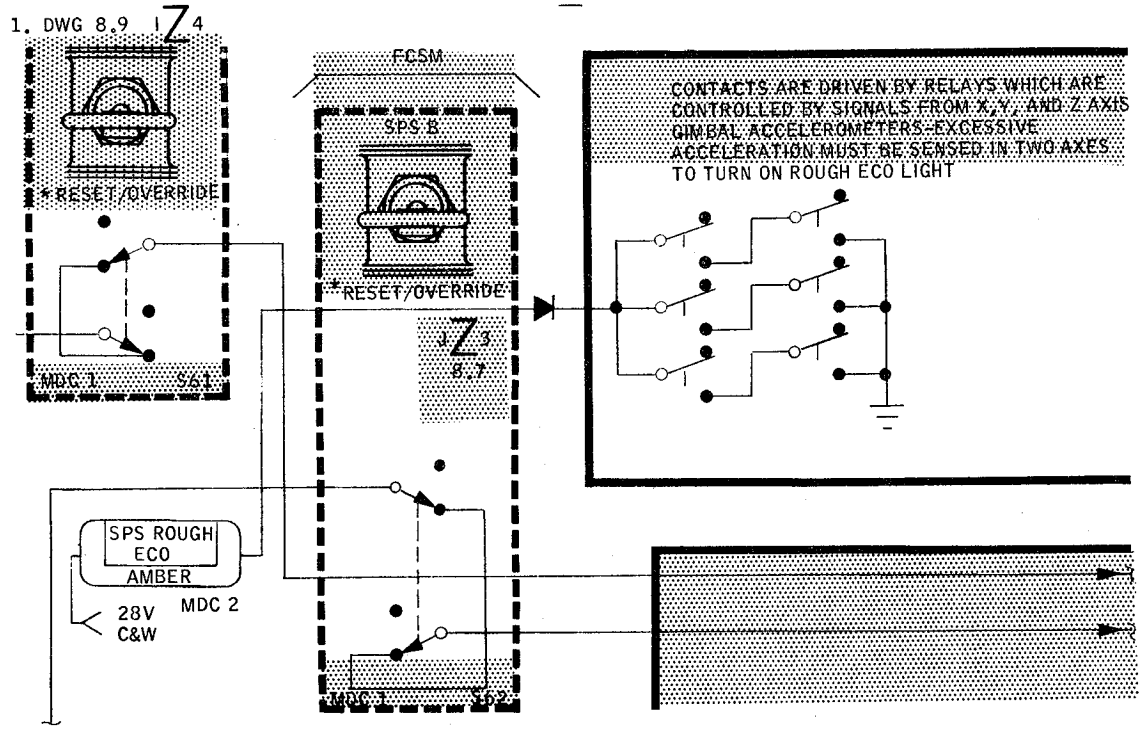
SCS CONTROL ELECTRONICS (ECA/TVC/GYROS)

CSM	SIZE	DWG NO.
104	J	8.9

115.5X38.25 PAGE SHEET 1 OF 1

SECTION 8

IS



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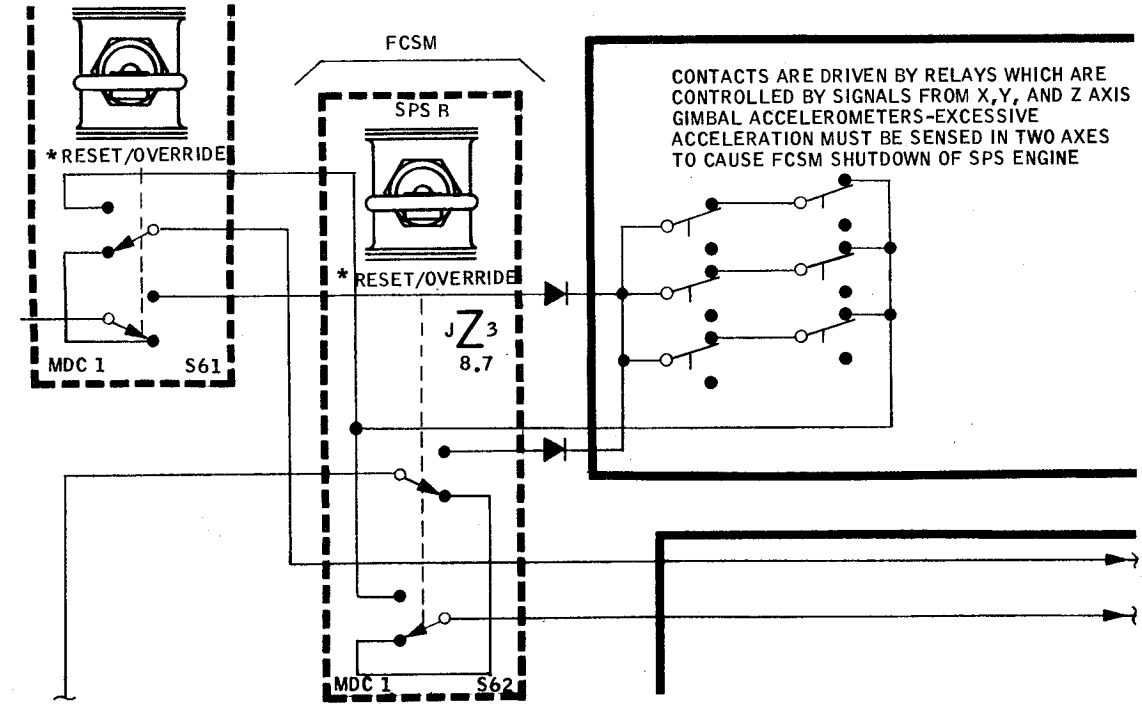
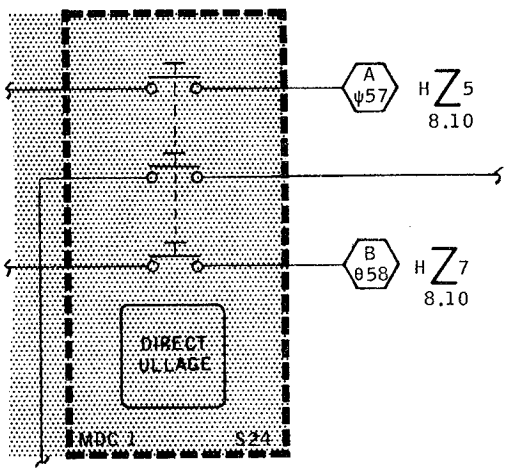


SECTION 8

IS

2. DWG 8.9 I Z 2



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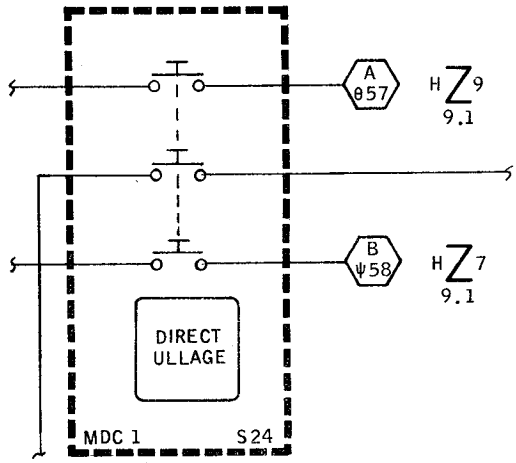
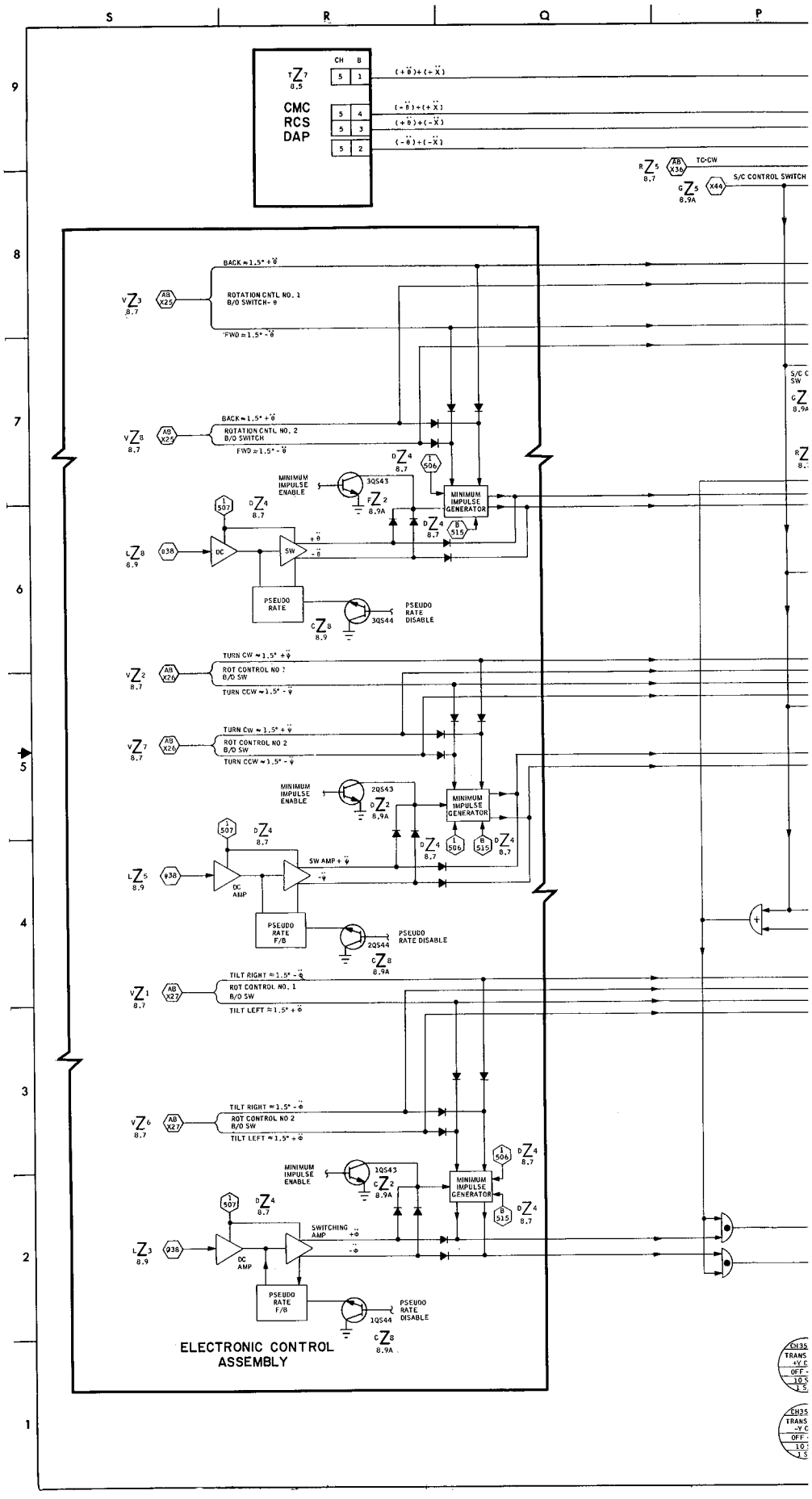
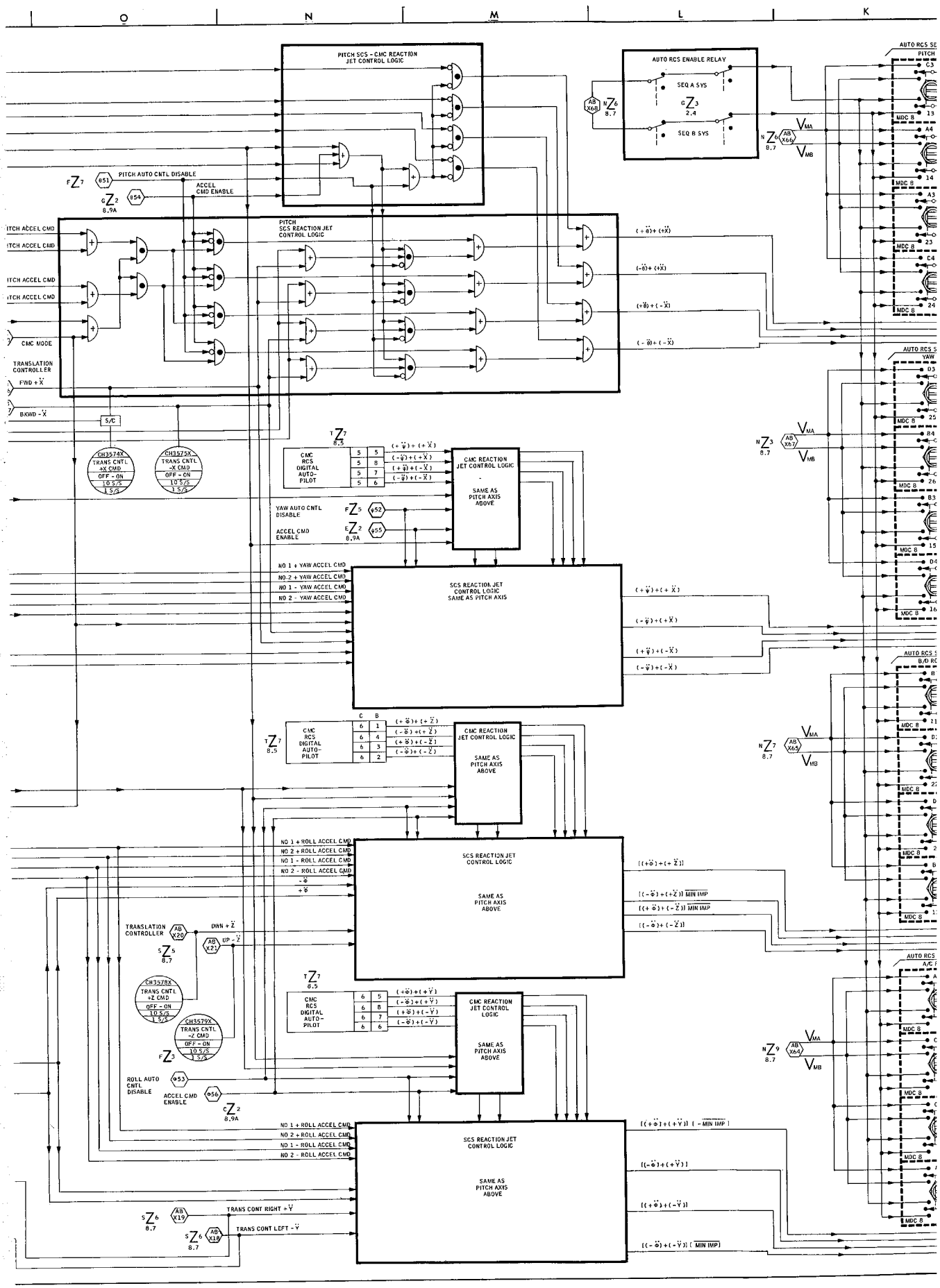
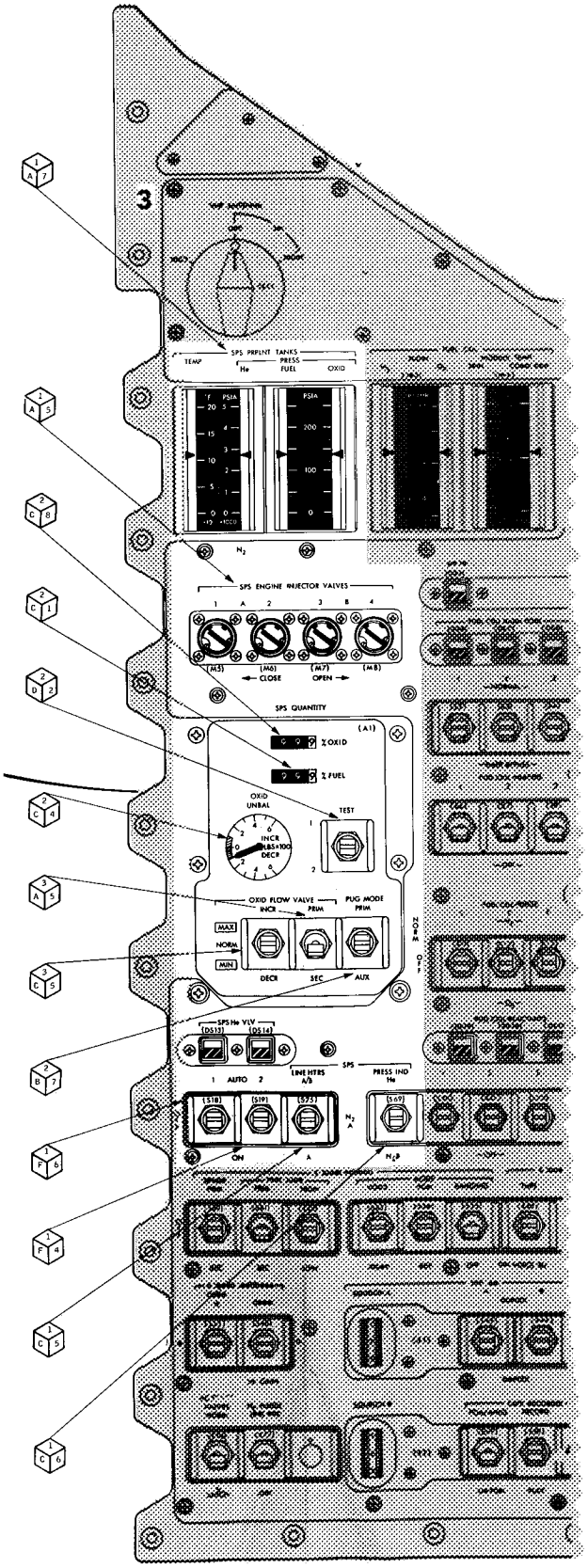
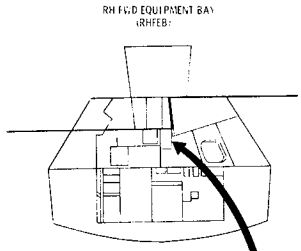
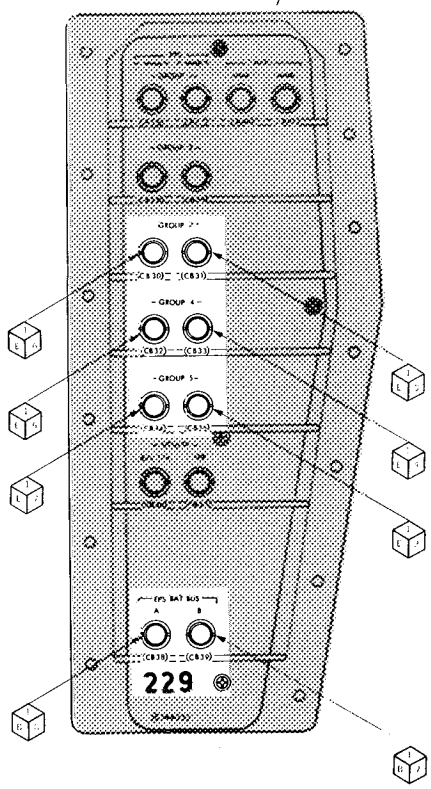


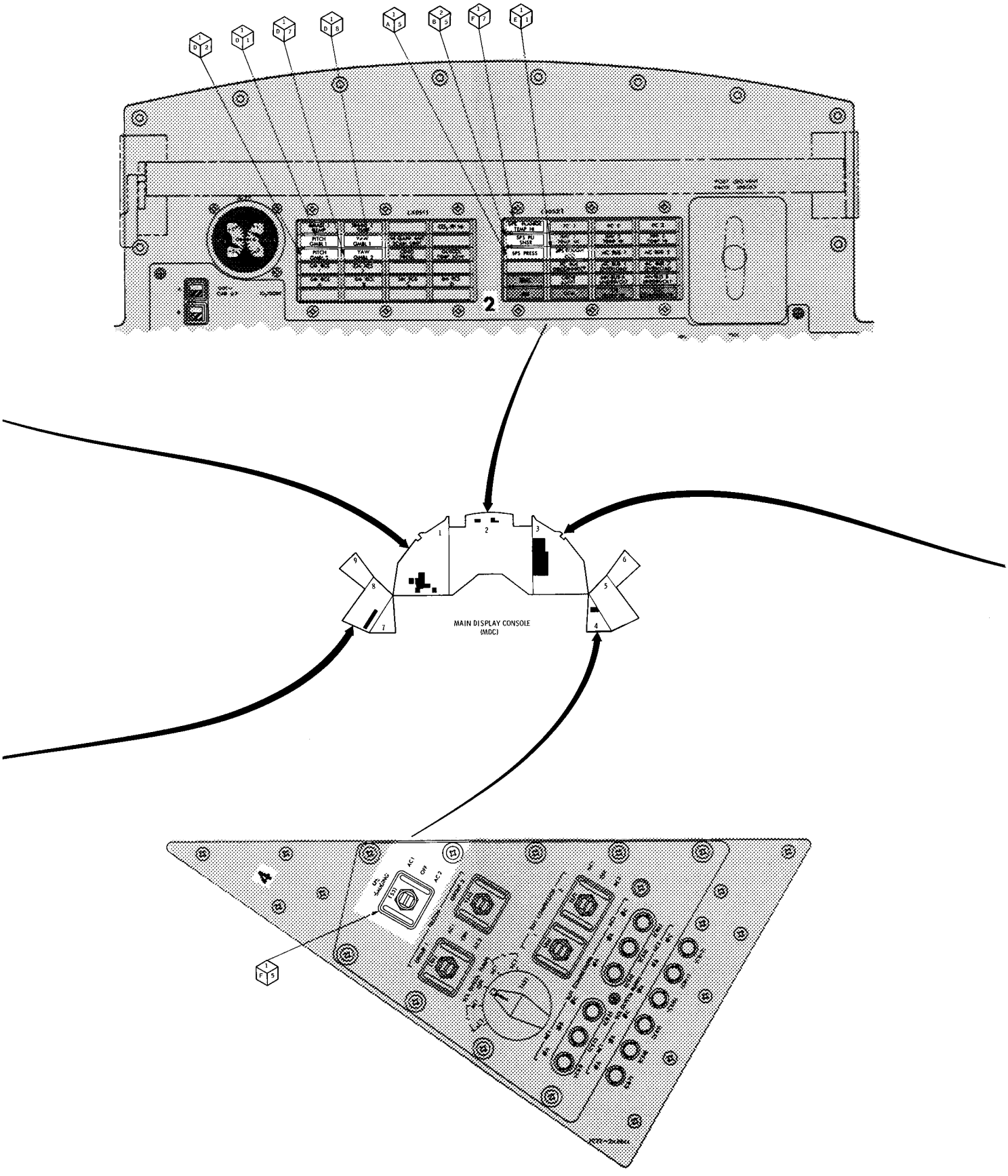

S
R
Q
P
9
8
7
6
5
4
3
2
1
CMC
RCS
DAP
CH B
5 1
5 4
5 3
5 2
(+θ̈)+(+ẍ)
(-θ̈)+(+ẍ)
(+θ̈)+(-ẍ)
(-θ̈)+(-ẍ)
TC-CW
S/C CONTROL SWITCH
BACK ≈ 1.5° +θ̈
ROTATION CNTL NO. 1 B/O SWITCH - θ
FWD ≈ 1.5° -θ̈
BACK ≈ 1.5° +θ̈
ROTATION CNTL NO. 2 B/O SWITCH
FWD ≈ 1.5° -θ̈
MINIMUM IMPULSE ENABLE
3QS43
MINIMUM IMPULSE GENERATOR
DC
SW
+θ̈
-θ̈
PSEUDO RATE
3QS44
PSEUDO RATE DISABLE
TURN CW ≈ 1.5° +ψ̈
ROT CONTROL NO 1 B/O SW
TURN CCW ≈ 1.5° -ψ̈
TURN CW ≈ 1.5° +ψ̈
ROT CONTROL NO 2 B/O SW
TURN CCW ≈ 1.5° -ψ̈
MINIMUM IMPULSE ENABLE
2QS43
MINIMUM IMPULSE GENERATOR
DC AMP
SW AMP +ψ̈
-ψ̈
PSEUDO RATE F/B
2QS44
PSEUDO RATE DISABLE
TILT RIGHT ≈ 1.5° -Φ̈
ROT CONTROL NO. 1 B/O SW
TILT LEFT ≈ 1.5° +Φ̈
TILT RIGHT ≈ 1.5° -Φ̈
ROT CONTROL NO 2 B/O SW
TILT LEFT ≈ 1.5° +Φ̈
MINIMUM IMPULSE ENABLE
1QS43
MINIMUM IMPULSE GENERATOR
SWITCHING AMP
+Φ̈
-Φ̈
DC AMP
PSEUDO RATE F/B
1QS44
PSEUDO RATE DISABLE
ELECTRONIC CONTROL ASSEMBLY

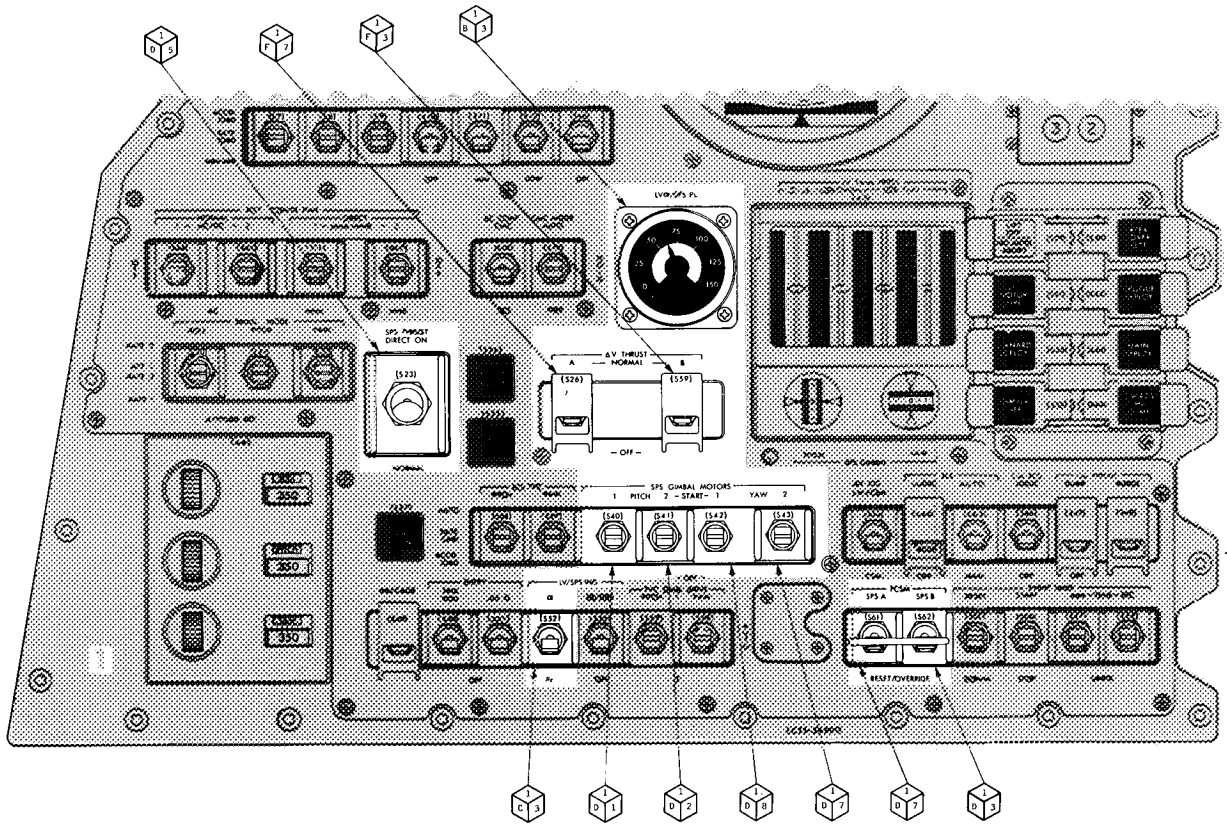

O
N
M
L
K
PITCH SCS - CMC REACTION JET CONTROL LOGIC
AUTO RCS ENABLE RELAY
SEQ A SYS
SEQ B SYS
PITCH AUTO CNTL DISABLE
ACCEL CMD ENABLE
PITCH SCS REACTION JET CONTROL LOGIC
CMC MODE
TRANSLATION CONTROLLER
FWD + X
BKWD - X
S/C
CH3574X TRANS CNTL +X CMD OFF - ON 10 S/S 1 S/S
CH3575X TRANS CNTL -X CMD OFF - ON 10 S/S 1 S/S
CMC RCS DIGITAL AUTO-PILOT
CMC REACTION JET CONTROL LOGIC
SAME AS PITCH AXIS ABOVE
YAW AUTO CNTL DISABLE
NO 1 + YAW ACCEL CMD
NO 2 + YAW ACCEL CMD
NO 1 - YAW ACCEL CMD
NO 2 - YAW ACCEL CMD
SCS REACTION JET CONTROL LOGIC
SAME AS PITCH AXIS ABOVE
NO 1 + ROLL ACCEL CMD
NO 2 + ROLL ACCEL CMD
NO 1 - ROLL ACCEL CMD
NO 2 - ROLL ACCEL CMD
TRANSLATION CONTROLLER
DWN + Z
UP - Z
CH3578X TRANS CNTL +Z CMD OFF - ON 10 S/S 1 S/S
CH3579X TRANS CNTL -Z CMD OFF - ON 10 S/S 1 S/S
ROLL AUTO CNTL DISABLE
TRANS CONT RIGHT + Y
TRANS CONT LEFT - Y
MIN IMP
AUTO RCS SE
PITCH
YAW
MDC 8

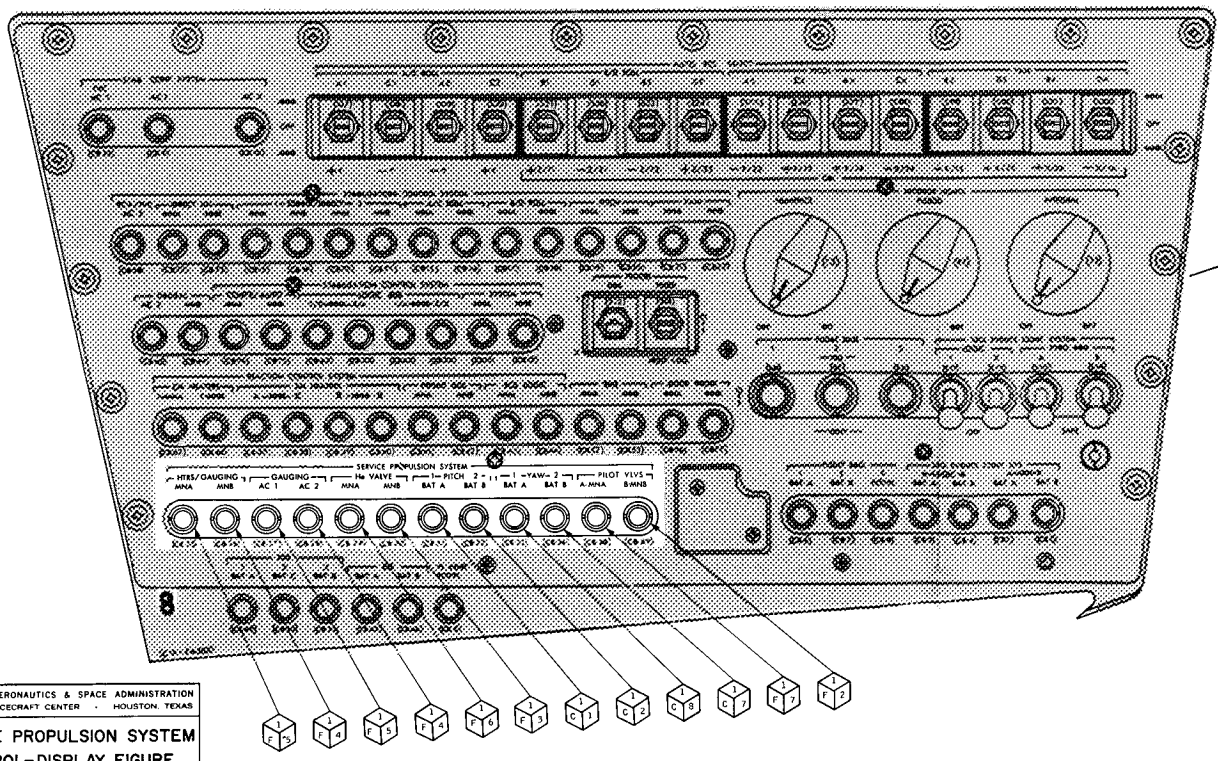

3
SPS PRPLNT TANKS
TEMP
PRESS
He
FUEL
OXID
PSIA
SPS ENGINE INJECTOR VALVES
1 A 2 3 B 4
(M5) (M6) (M7) (M8)
CLOSE
OPEN
SPS QUANTITY
(A1)
% OXID
% FUEL
OXID UNBAL
INCR
LBS×100
DECR
TEST
OXID FLOW VALVE
INCR
PRIM
PLUG MODE
PRIM
MAX
NORM
MIN
DECR
SEC
AUX
SPS He VLV
(D33)
(D34)
1 AUTO 2
LINE HTRS
A/B
SPS
PRESS IND
He
(S18)
(S19)
(S75)
(S69)
ON
A
B
ZOOM


RH FWD EQUIPMENT BAY
(RHFEB)
RH EQUIPMENT BAY
(RHEB)


GROUP 3
(CB30)
(CB31)
GROUP 4
(CB32)
(CB33)
GROUP 5
(CB34)
(CB35)
EPS BAT BUS
A
B
(CB38)
(CB39)
229


2
MAIN DISPLAY CONSOLE
(MDC)
4



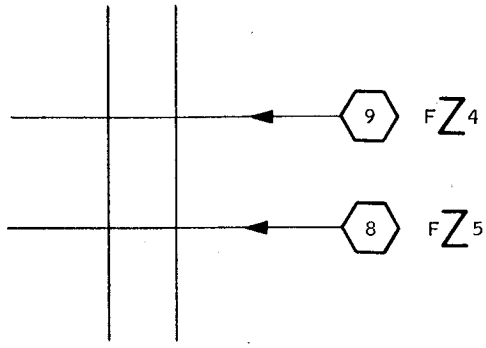


NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER · HOUSTON, TEXAS		
SERVICE PROPULSION SYSTEM CONTROL-DISPLAY FIGURE		
DWG NO. FIGURE 9.1	SIZE J	CSM 104
SHEET OF PAGE		78.5 X 36

SECTION 9

1. DWG 9.1 C,B Z 5

IS



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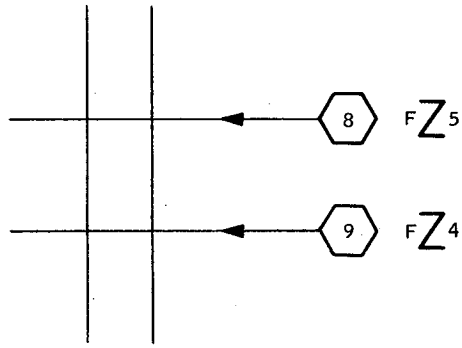
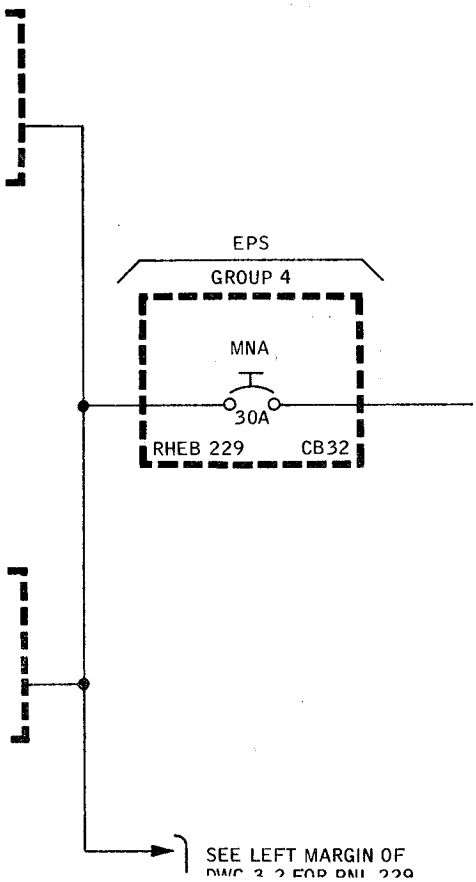
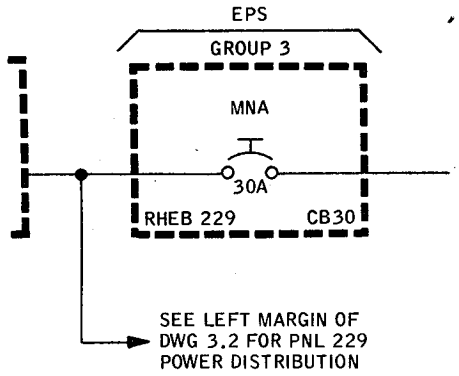
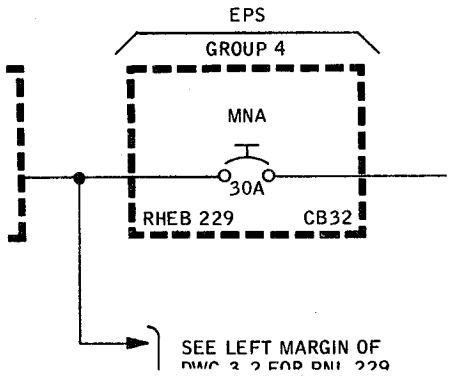


2. DWG 9.1 E Z 6,5

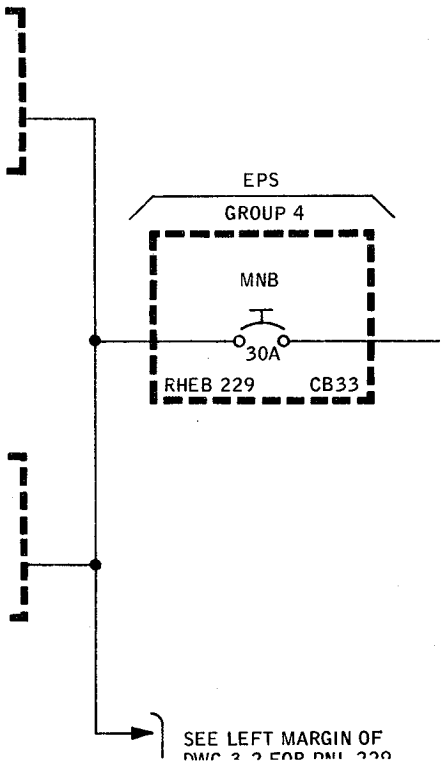






IS

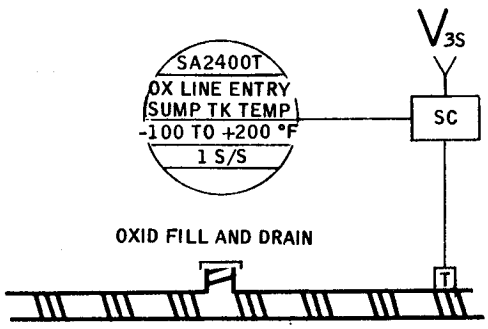
3. DWG 9.1 E Z 3,2



4. DWG 9.1 A Z 3

THRUST 20,500±205 LBS DOUBLE BANK
20,000±200 LBS SINGLE BANK

5. DWG 9.1 J Z 6



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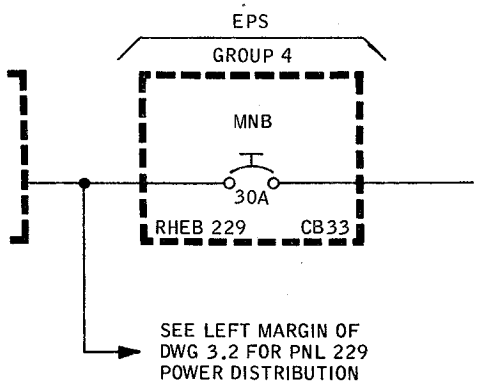
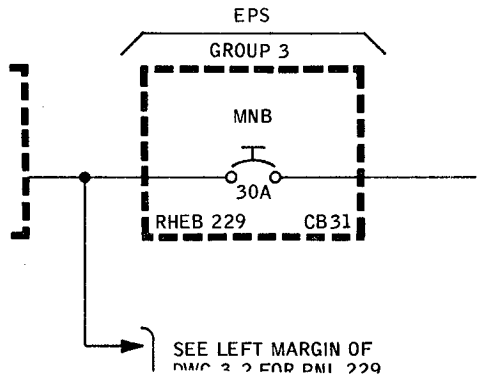
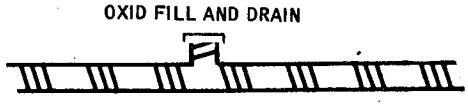




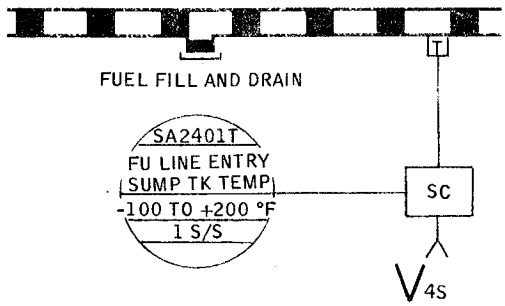
THRUST 20,000±200 LBS



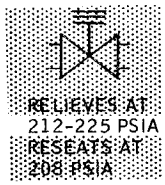
SECTION 9

IS

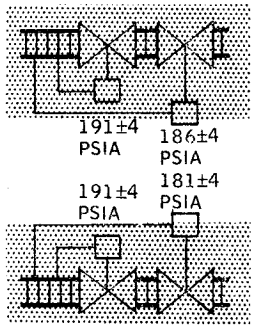
6. DWG 9.1 J Z3



7. DWG 9.1 L Z6

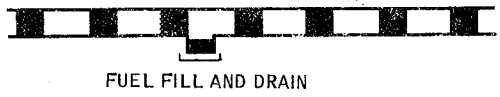


8. DWG 9.1 L Z4

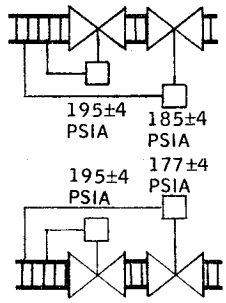


9. DWG 9.1 L Z3

WAS



RELIEVES AT
232±8 PSIA
RESEATS AT
208 PSIA

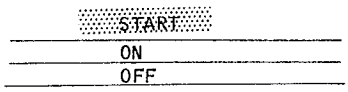


RELIEVES AT
232±8 PSIA
RESEATS AT
208 PSIA

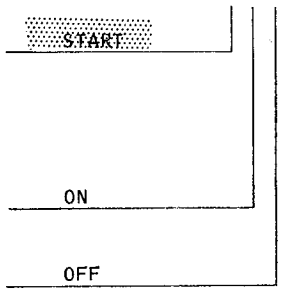
SECTION 9

IS

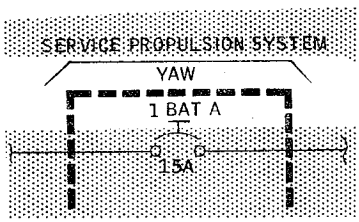
10. DWG 9.1 S Z 8



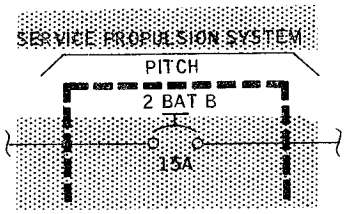
11. DWG 9.1 S Z 7



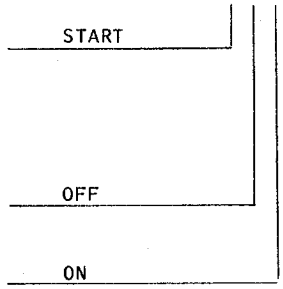
12. DWG 9.1 C 8

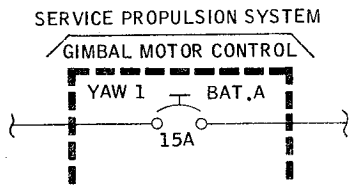


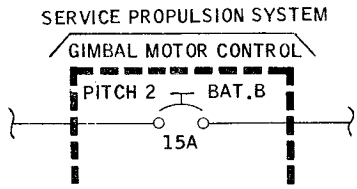
13. DWG 9.1 C 2

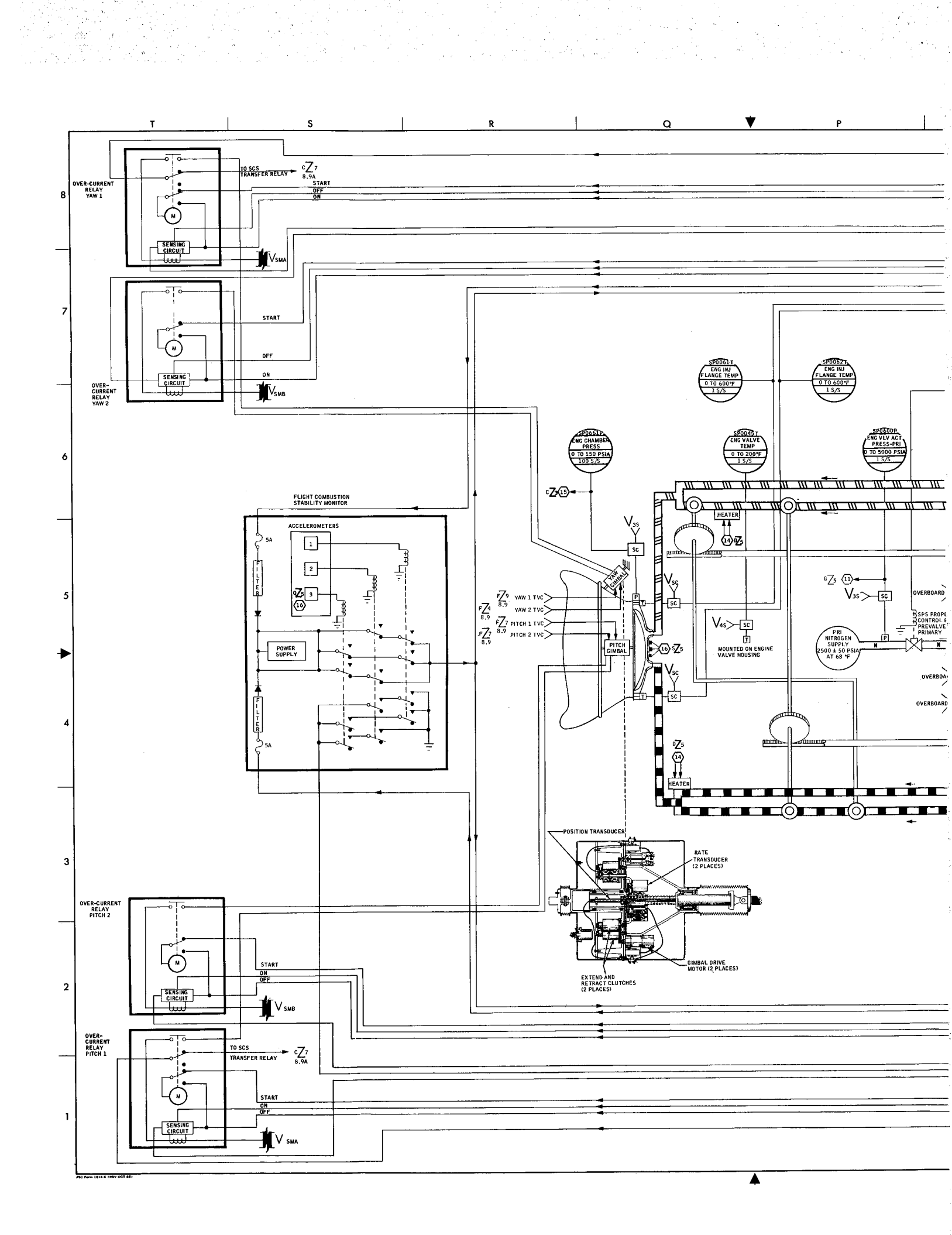


WAS








T
S
R
Q
P
8
7
6
5
4
3
2
1
OVER-CURRENT RELAY YAW 1
TO SCS TRANSFER RELAY
8.9A
START
OFF
ON
SENSING CIRCUIT
VSMA
OVER-CURRENT RELAY YAW 2
VSMB
SP0061T ENG INJ FLANGE TEMP 0 TO 600°F 1 S/S
SP0062T ENG INJ FLANGE TEMP 0 TO 600°F 1 S/S
SP0061P ENG CHAMBER PRESS 0 TO 150 PSIA 100 S/S
SP0045T ENG VALVE TEMP 0 TO 200°F 1 S/S
SP0600P ENG VLV ACT PRESS-PRI 0 TO 5000 PSIA 1 S/S
FLIGHT COMBUSTION STABILITY MONITOR
ACCELEROMETERS
FILTER
POWER SUPPLY
YAW 1 TVC
YAW 2 TVC
PITCH 1 TVC
PITCH 2 TVC
YAW GIMBAL
PITCH GIMBAL
HEATER
MOUNTED ON ENGINE VALVE HOUSING
PRI NITROGEN SUPPLY 2500 ± 50 PSIA AT 68 °F
OVERBOARD
POSITION TRANSDUCER
RATE TRANSDUCER (2 PLACES)
GIMBAL DRIVE MOTOR (2 PLACES)
EXTEND AND RETRACT CLUTCHES (2 PLACES)
OVER-CURRENT RELAY PITCH 2
OVER-CURRENT RELAY PITCH 1

O N M L K

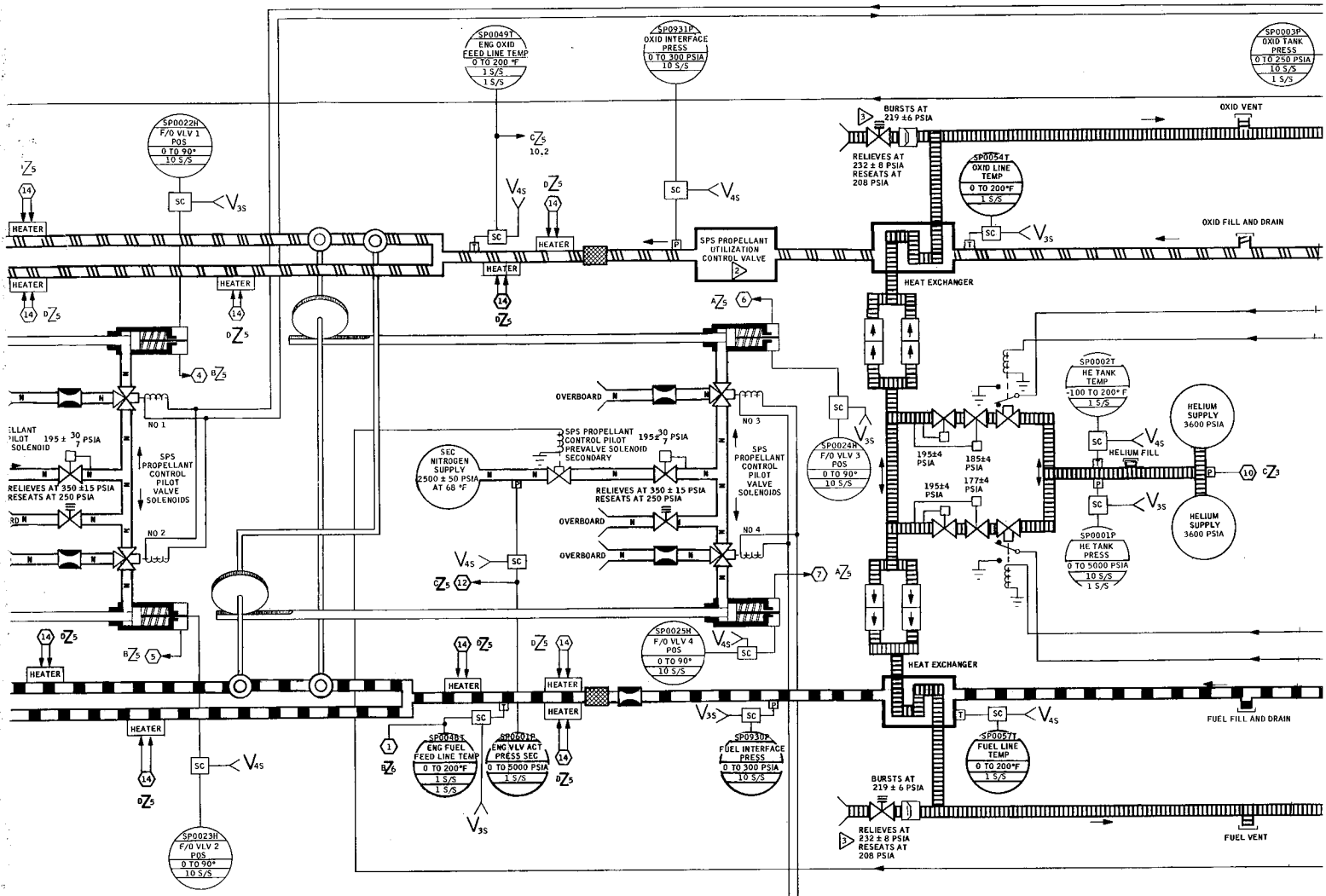
YAW GIMBAL 1

YAW GIMBAL 1 C&W LITE

YAW GIMBAL 2 C&W LITE

YAW GIMBAL 2

SPS FLANGE TEMP - C&W LITE



PITCH GIMBAL 2

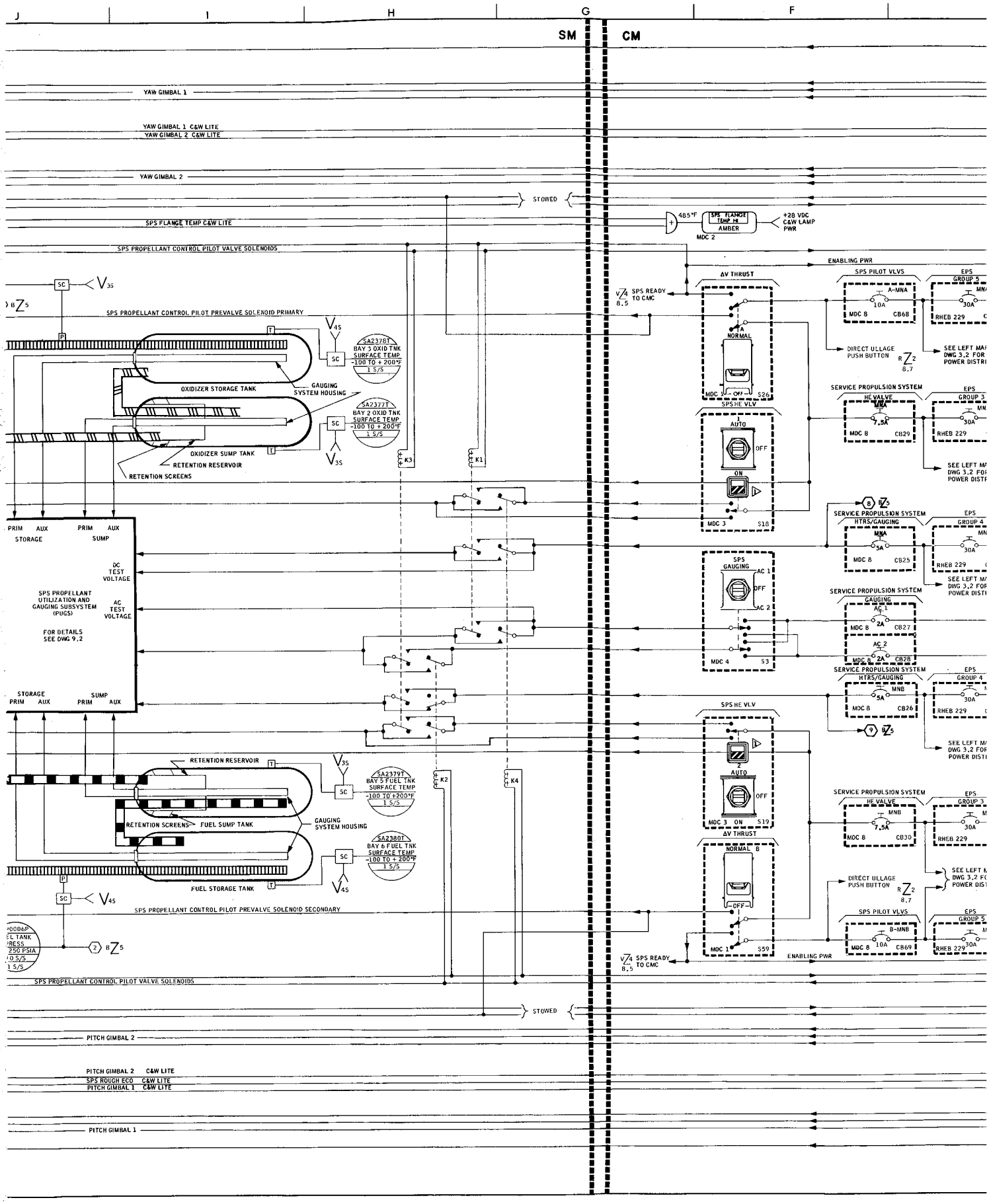
PITCH GIMBAL 2 C&W LITE

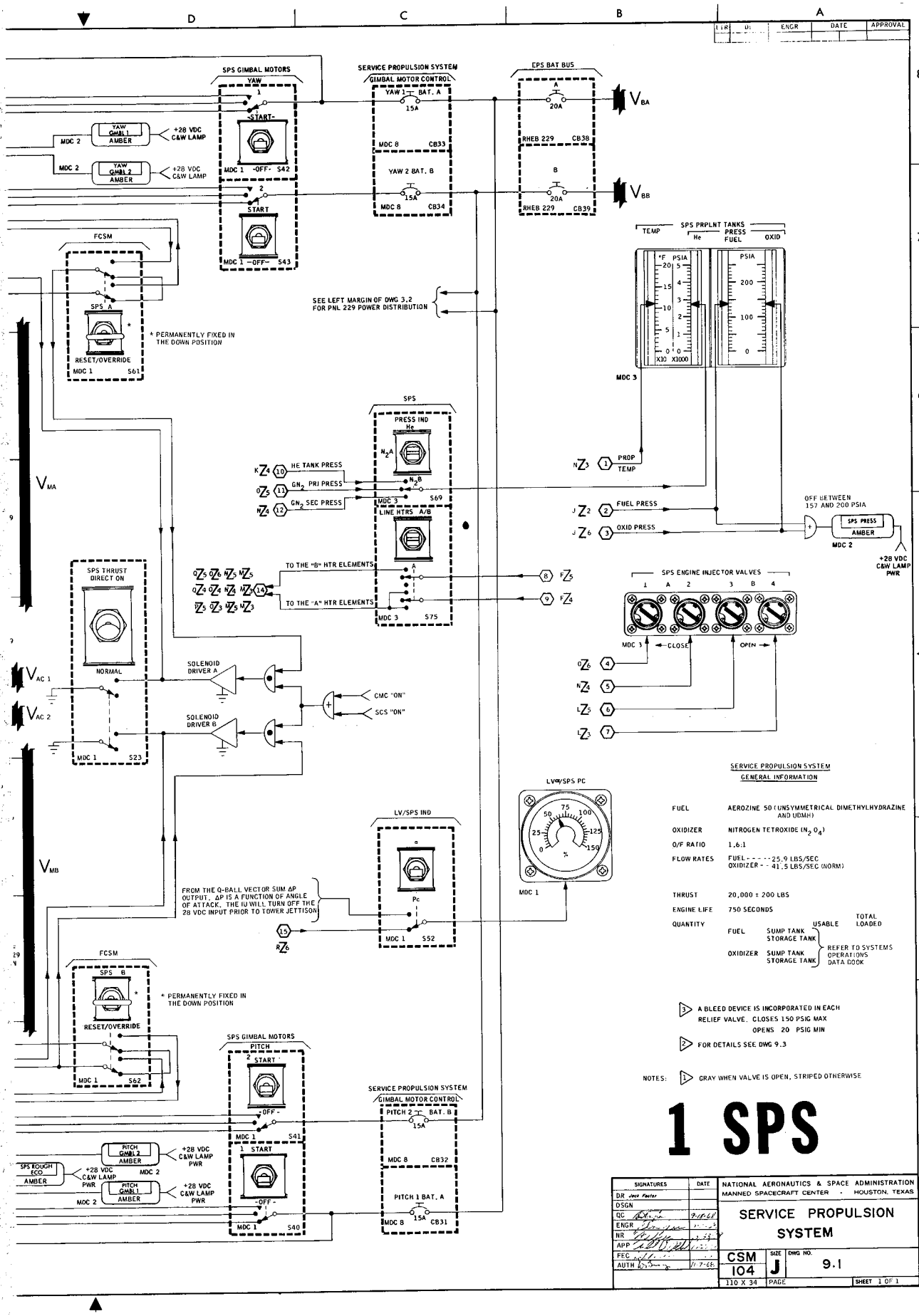
SPS ROUGH ECO C&W LITE

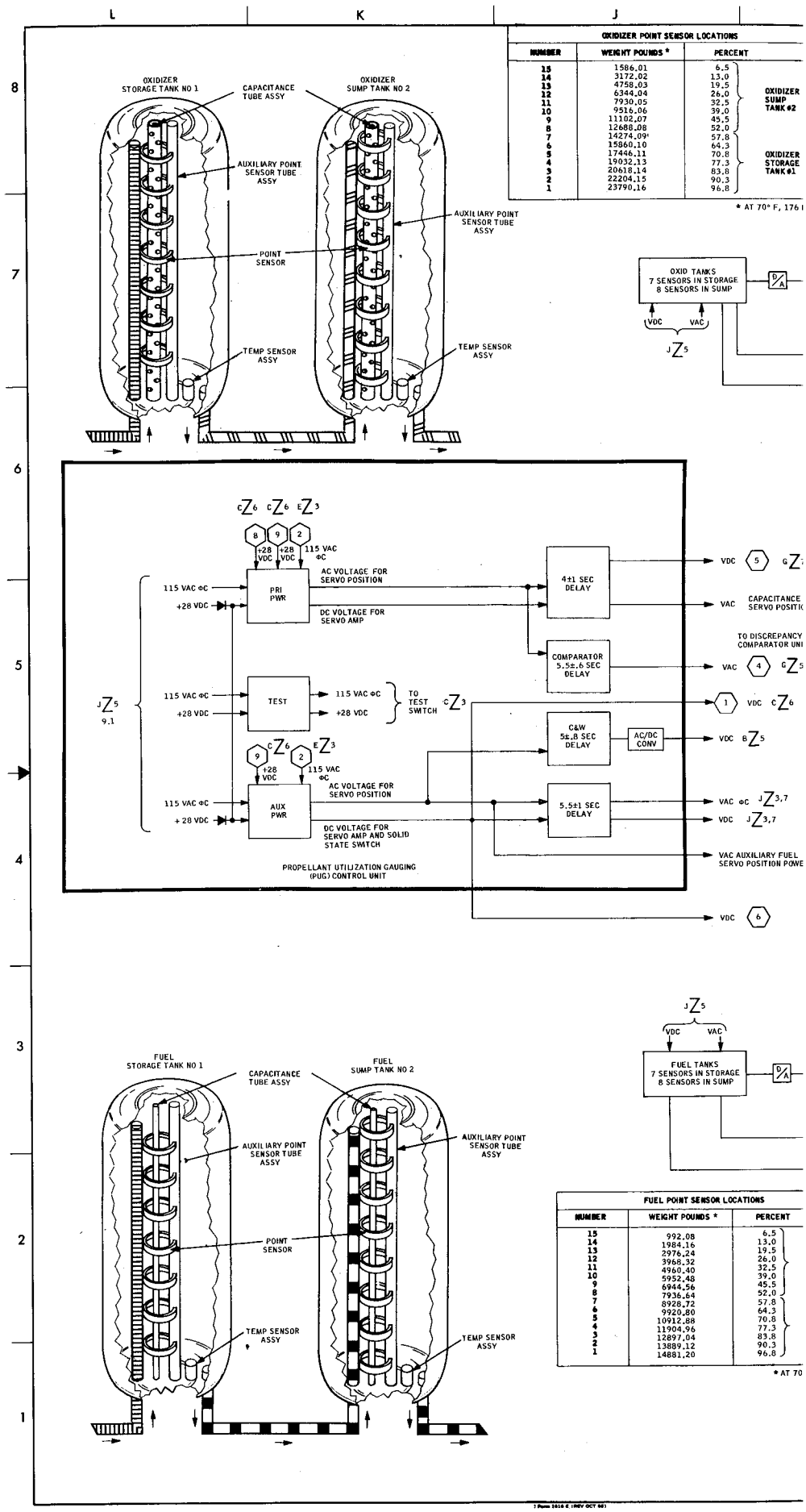
PITCH GIMBAL 1 C&W LITE

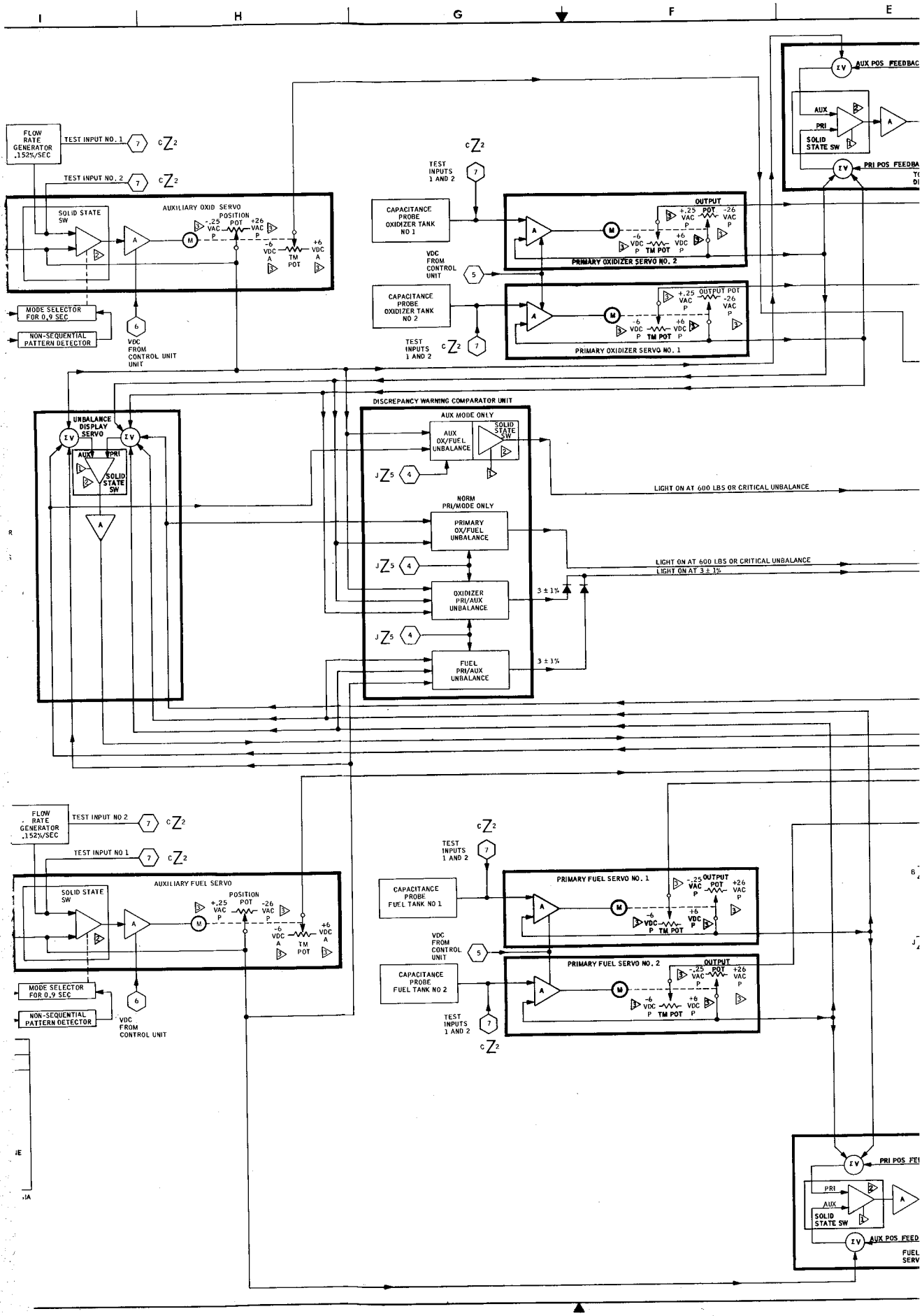
PITCH GIMBAL 1

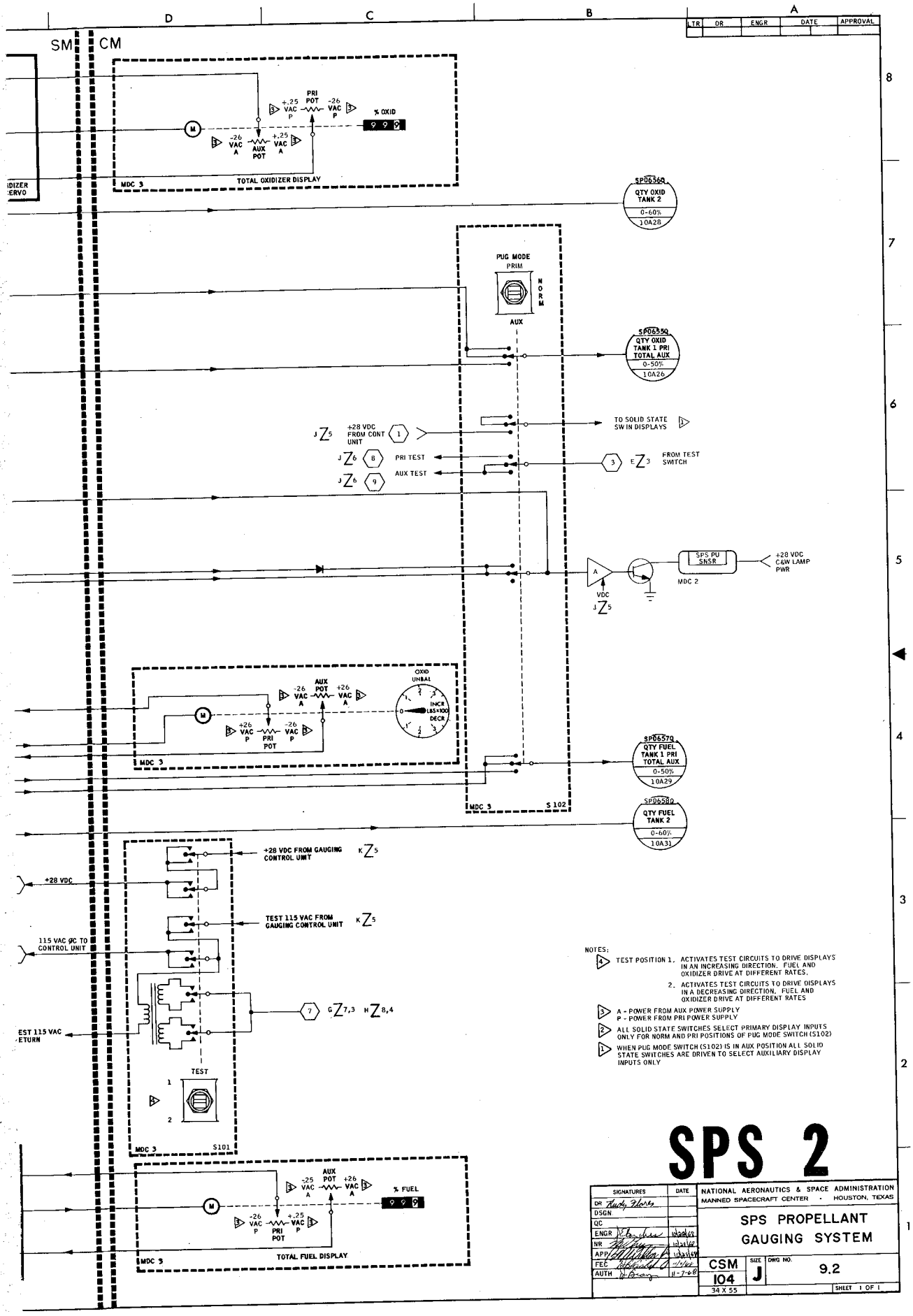
(REV OCT 69)


J
I
H
G
F
SM
CM
YAW GIMBAL 1
YAW GIMBAL 1 C&W LITE
YAW GIMBAL 2 C&W LITE
YAW GIMBAL 2
STOWED
SPS FLANGE TEMP C&W LITE
485°F
SPS FLANGE TEMP HI
AMBER
MDC 2
+28 VDC C&W LAMP PWR
SPS PROPELLANT CONTROL PILOT VALVE SOLENOIDS
ENABLING PWR
SPS PROPELLANT CONTROL PILOT PREVALVE SOLENOID PRIMARY
ΔV THRUST
SPS PILOT VLVS
SPS READY TO CMC
8.5
A-MNA
10A
MDC 8
CB68
GROUP 5
30A
RHEB 229
DIRECT ULLAGE PUSH BUTTON
8.7
SEE LEFT MA DWG 3.2 FOR POWER DISTRI
OXIDIZER STORAGE TANK
GAUGING SYSTEM HOUSING
SA2378T
BAY 3 OXID TNK SURFACE TEMP
-100 TO +200°F
1 S/S
SA2377T
BAY 2 OXID TNK SURFACE TEMP
-100 TO +200°F
1 S/S
OXIDIZER SUMP TANK
RETENTION RESERVOIR
RETENTION SCREENS
NORMAL
MDC 1
OFF
S26
SERVICE PROPULSION SYSTEM
HE VALVE
MNA
7.5A
MDC 8
CB29
SPS HE VLV
AUTO
OFF
ON
MDC 3
S18
SERVICE PROPULSION SYSTEM
HTRS/GAUGING
MNA
5A
MDC 8
CB25
PRIM AUX STORAGE
PRIM AUX SUMP
DC TEST VOLTAGE
AC TEST VOLTAGE
SPS PROPELLANT UTILIZATION AND GAUGING SUBSYSTEM (PUGS)
FOR DETAILS SEE DWG 9.2
SPS GAUGING
AC 1
OFF
AC 2
MDC 4
S3
SERVICE PROPULSION SYSTEM
GAUGING
AC 1
2A
MDC 8
CB27
AC 2
2A
CB28
STORAGE PRIM AUX
SUMP PRIM AUX
SERVICE PROPULSION SYSTEM
HTRS/GAUGING
MNB
5A
MDC 8
CB26
SPS HE VLV
2
AUTO
OFF
MDC 3
ON
S19
RETENTION RESERVOIR
SA2379T
BAY 5 FUEL TNK SURFACE TEMP
-100 TO +200°F
1 S/S
RETENTION SCREENS
FUEL SUMP TANK
GAUGING SYSTEM HOUSING
SA2380T
BAY 6 FUEL TNK SURFACE TEMP
-100 TO +200°F
1 S/S
FUEL STORAGE TANK
ΔV THRUST
NORMAL
B
OFF
MDC 1
S59
SERVICE PROPULSION SYSTEM
HE VALVE
MNB
7.5A
MDC 8
CB30
DIRECT ULLAGE PUSH BUTTON
8.7
SPS PILOT VLVS
B-MNB
10A
MDC 8
CB69
SPS PROPELLANT CONTROL PILOT PREVALVE SOLENOID SECONDARY
SPS PROPELLANT CONTROL PILOT VALVE SOLENOIDS
STOWED
PITCH GIMBAL 2
PITCH GIMBAL 2 C&W LITE
SPS ROUGH ECO C&W LITE
PITCH GIMBAL 1 C&W LITE
PITCH GIMBAL 1


SPS GIMBAL MOTORS
YAW
SERVICE PROPULSION SYSTEM
GIMBAL MOTOR CONTROL
EPS BAT BUS
YAW 1 BAT. A
15A
MDC 8 CB33
YAW 2 BAT. B
MDC 8 CB34
RHEB 229 CB38
RHEB 229 CB39
V_{BA}
V_{BB}
YAW GMBL 1 AMBER
YAW GMBL 2 AMBER
+28 VDC C&W LAMP
-START-
-OFF-
S42
S43
FCSM
SPS A
RESET/OVERRIDE
MDC 1 S61
* PERMANENTLY FIXED IN THE DOWN POSITION
SEE LEFT MARGIN OF DWG 3.2 FOR PNL 229 POWER DISTRIBUTION
SPS PRPLNT TANKS
TEMP
PRESS
He
FUEL
OXID
°F
PSIA
MDC 3
SPS
PRESS IND
He
N_2A
N_2B
HE TANK PRESS
GN_2 PRI PRESS
GN_2 SEC PRESS
S69
LINE HTRS A/B
PROP TEMP
FUEL PRESS
OXID PRESS
OFF BETWEEN 157 AND 200 PSIA
SPS PRESS AMBER
MDC 2
+28 VDC C&W LAMP PWR
SPS THRUST DIRECT ON
NORMAL
MDC 1 S23
$V_{AC 1}$
$V_{AC 2}$
V_{MA}
V_{MB}
SOLENOID DRIVER A
SOLENOID DRIVER B
CMC "ON"
SCS "ON"
TO THE "B" HTR ELEMENTS
TO THE "A" HTR ELEMENTS
S75
SPS ENGINE INJECTOR VALVES
1 A 2 3 B 4
CLOSE
OPEN
MDC 1
LV/SPS PC
LV/SPS IND
Pc
MDC 1 S52
FROM THE Q-BALL VECTOR SUM ΔP OUTPUT. ΔP IS A FUNCTION OF ANGLE OF ATTACK. THE IU WILL TURN OFF THE 28 VDC INPUT PRIOR TO TOWER JETTISON
FCSM
SPS B
RESET/OVERRIDE
MDC 1 S62
* PERMANENTLY FIXED IN THE DOWN POSITION
SPS GIMBAL MOTORS
PITCH
SERVICE PROPULSION SYSTEM
GIMBAL MOTOR CONTROL
PITCH 2 BAT. B
PITCH 1 BAT. A
MDC 8 CB32
MDC 8 CB31
PITCH GMBL 2 AMBER
PITCH GMBL 1 AMBER
SPS ROUGH ECO AMBER
MDC 1 S41
MDC 1 S40
SERVICE PROPULSION SYSTEM
GENERAL INFORMATION
FUEL AEROZINE 50 (UNSYMMETRICAL DIMETHYLHYDRAZINE AND UDMH)
OXIDIZER NITROGEN TETROXIDE (N_2O_4)
O/F RATIO 1.6:1
FLOW RATES FUEL - - - - - 25.9 LBS/SEC
OXIDIZER - - 41.5 LBS/SEC (NORM)
THRUST 20,000 ± 200 LBS
ENGINE LIFE 750 SECONDS
QUANTITY
USABLE
TOTAL LOADED
FUEL SUMP TANK
STORAGE TANK
OXIDIZER SUMP TANK
STORAGE TANK
REFER TO SYSTEMS OPERATIONS DATA BOOK
3 A BLEED DEVICE IS INCORPORATED IN EACH RELIEF VALVE. CLOSES 150 PSIG MAX OPENS 20 PSIG MIN
2 FOR DETAILS SEE DWG 9.3
NOTES: 1 GRAY WHEN VALVE IS OPEN, STRIPED OTHERWISE
1 SPS
SIGNATURES
DATE
DR
DSGN
QC
ENGR
NR
APP
FEC
AUTH
NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS
SERVICE PROPULSION SYSTEM
CSM 104
SIZE J
DWG NO. 9.1
110 X 34
PAGE
SHEET 1 OF 1


L
K
J
8
7
6
5
4
3
2
1
OXIDIZER STORAGE TANK NO 1
CAPACITANCE TUBE ASSY
OXIDIZER SUMP TANK NO 2
AUXILIARY POINT SENSOR TUBE ASSY
AUXILIARY POINT SENSOR TUBE ASSY
POINT SENSOR
TEMP SENSOR ASSY
TEMP SENSOR ASSY
OXIDIZER POINT SENSOR LOCATIONS
NUMBER | WEIGHT POUNDS * | PERCENT
15 1586.01 6.5
14 3172.02 13.0
13 4758.03 19.5
12 6344.04 26.0
11 7930.05 32.5
10 9516.06 39.0
9 11102.07 49.5
8 12688.08 52.0
7 14274.09 57.8
6 15860.10 64.3
5 17446.11 70.8
4 19032.13 77.3
3 20618.14 83.8
2 22204.15 90.3
1 23790.16 96.8
OXIDIZER SUMP TANK #2
OXIDIZER STORAGE TANK #1
* AT 70° F, 176
OXID TANKS 7 SENSORS IN STORAGE 8 SENSORS IN SUMP
D/A
VDC
VAC
J Z 5
C Z 6 C Z 6 E Z 3
8 9 2
+28 VDC +28 VDC 115 VAC ΦC
115 VAC ΦC
+28 VDC
PRI PWR
AC VOLTAGE FOR SERVO POSITION
DC VOLTAGE FOR SERVO AMP
4±1 SEC DELAY
COMPARATOR 5.5±.6 SEC DELAY
TEST
115 VAC ΦC
+28 VDC
TO TEST SWITCH C Z 3
C&W 5±.8 SEC DELAY
AC/DC CONV
9 2
AUX PWR
AC VOLTAGE FOR SERVO POSITION
DC VOLTAGE FOR SERVO AMP AND SOLID STATE SWITCH
5.5±1 SEC DELAY
PROPELLANT UTILIZATION GAUGING (PUG) CONTROL UNIT
VDC 5 G Z
VAC CAPACITANCE SERVO POSITI
TO DISCREPANCY COMPARATOR UNI
VAC 4 G Z 5
1 VDC C Z 6
VDC B Z 5
VAC ΦC J Z 3,7
VDC J Z 3,7
VAC AUXILIARY FUEL SERVO POSITION POWE
VDC 6
J Z 5
VDC VAC
FUEL TANKS 7 SENSORS IN STORAGE 8 SENSORS IN SUMP
D/A
FUEL STORAGE TANK NO 1
CAPACITANCE TUBE ASSY
FUEL SUMP TANK NO 2
AUXILIARY POINT SENSOR TUBE ASSY
AUXILIARY POINT SENSOR TUBE ASSY
POINT SENSOR
TEMP SENSOR ASSY
TEMP SENSOR ASSY
FUEL POINT SENSOR LOCATIONS
NUMBER | WEIGHT POUNDS * | PERCENT
15 992.08 6.5
14 1984.16 13.0
13 2976.24 19.5
12 3968.32 26.0
11 4960.40 32.5
10 5952.48 39.0
9 6944.56 45.5
8 7936.64 52.0
7 8928.72 57.8
6 9920.80 64.3
5 10912.88 70.8
4 11904.96 77.3
3 12897.04 83.8
2 13889.12 90.3
1 14881.20 96.8
* AT 70


I
H
G
F
E
FLOW RATE GENERATOR .152%/SEC
TEST INPUT NO. 1
TEST INPUT NO. 2
SOLID STATE SW
AUXILIARY OXID SERVO POSITION
-.25 VAC P
POT
+26 VAC P
-6 VDC A
TM POT
+6 VDC A
MODE SELECTOR FOR 0,9 SEC
NON-SEQUENTIAL PATTERN DETECTOR
VDC FROM CONTROL UNIT UNIT
CAPACITANCE PROBE OXIDIZER TANK NO 1
CAPACITANCE PROBE OXIDIZER TANK NO 2
TEST INPUTS 1 AND 2
VDC FROM CONTROL UNIT
OUTPUT POT
+.25 VAC P
-26 VAC P
-6 VDC P
TM POT
+6 VDC P
PRIMARY OXIDIZER SERVO NO. 2
PRIMARY OXIDIZER SERVO NO. 1
AUX POS FEEDBAC
AUX
PRI
SOLID STATE SW
PRI POS FEEDBA
UNBALANCE DISPLAY SERVO
DISCREPANCY WARNING COMPARATOR UNIT
AUX MODE ONLY
AUX OX/FUEL UNBALANCE
NORM PRI/MODE ONLY
PRIMARY OX/FUEL UNBALANCE
OXIDIZER PRI/AUX UNBALANCE
FUEL PRI/AUX UNBALANCE
3 ± 1%
LIGHT ON AT 600 LBS OR CRITICAL UNBALANCE
LIGHT ON AT 3 ± 1%
AUXILIARY FUEL SERVO
CAPACITANCE PROBE FUEL TANK NO 1
CAPACITANCE PROBE FUEL TANK NO 2
PRIMARY FUEL SERVO NO. 1
PRIMARY FUEL SERVO NO. 2
PRI POS FE
AUX POS FEED
FUEL SERV



NOTES:

4. TEST POSITION 1. ACTIVATES TEST CIRCUITS TO DRIVE DISPLAYS IN AN INCREASING DIRECTION. FUEL AND OXIDIZER DRIVE AT DIFFERENT RATES.
   2. ACTIVATES TEST CIRCUITS TO DRIVE DISPLAYS IN A DECREASING DIRECTION. FUEL AND OXIDIZER DRIVE AT DIFFERENT RATES
3. A - POWER FROM AUX POWER SUPPLY
   P - POWER FROM PRI POWER SUPPLY
2. ALL SOLID STATE SWITCHES SELECT PRIMARY DISPLAY INPUTS ONLY FOR NORM AND PRI POSITIONS OF PUG MODE SWITCH (S102)
1. WHEN PUG MODE SWITCH (S102) IS IN AUX POSITION ALL SOLID STATE SWITCHES ARE DRIVEN TO SELECT AUXILIARY DISPLAY INPUTS ONLY

SPS 2

SIGNATURES		DATE
DR	Rudy Flores	
DSGN		
QC		
ENGR	Charles	10/26/68
NR		10/25/68
APP		10/25/68
FEC		11/1/68
AUTH	H Bragg	11-7-68

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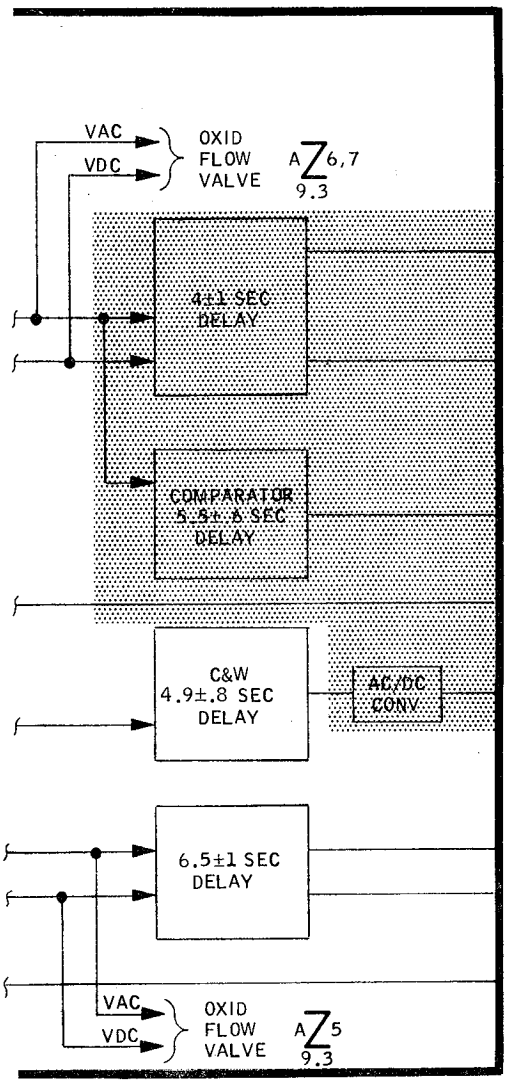
SPS PROPELLANT GAUGING SYSTEM

CSM	SIZE	DWG NO.
104	J	9.2
34 X 55		SHEET 1 OF 1

SECTION 9

IS

1. DWG 9.2 J Z 5

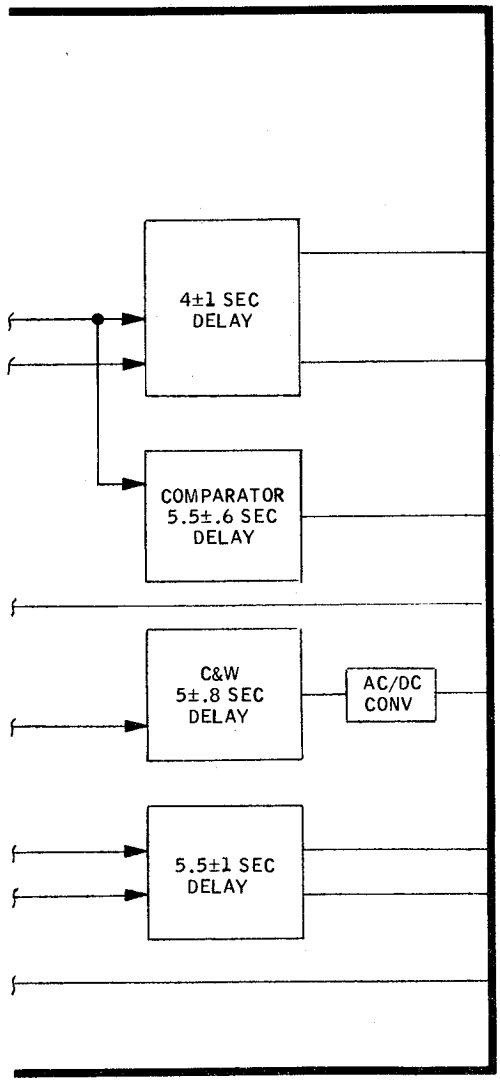


2. DWG 9.2 I Z 8

TEST INPUT NO 2 7

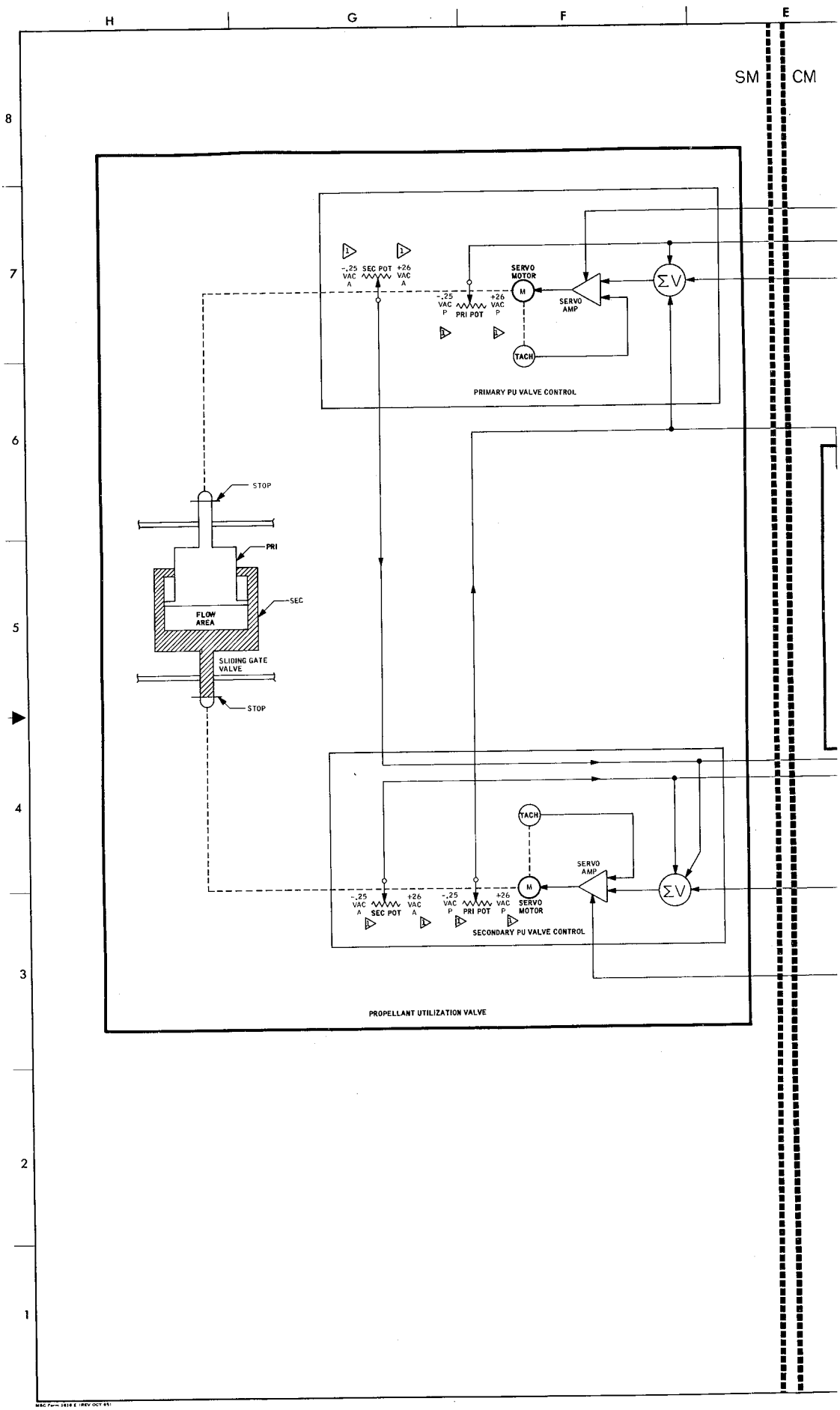
TEST INPUT NO 1 7

WAS

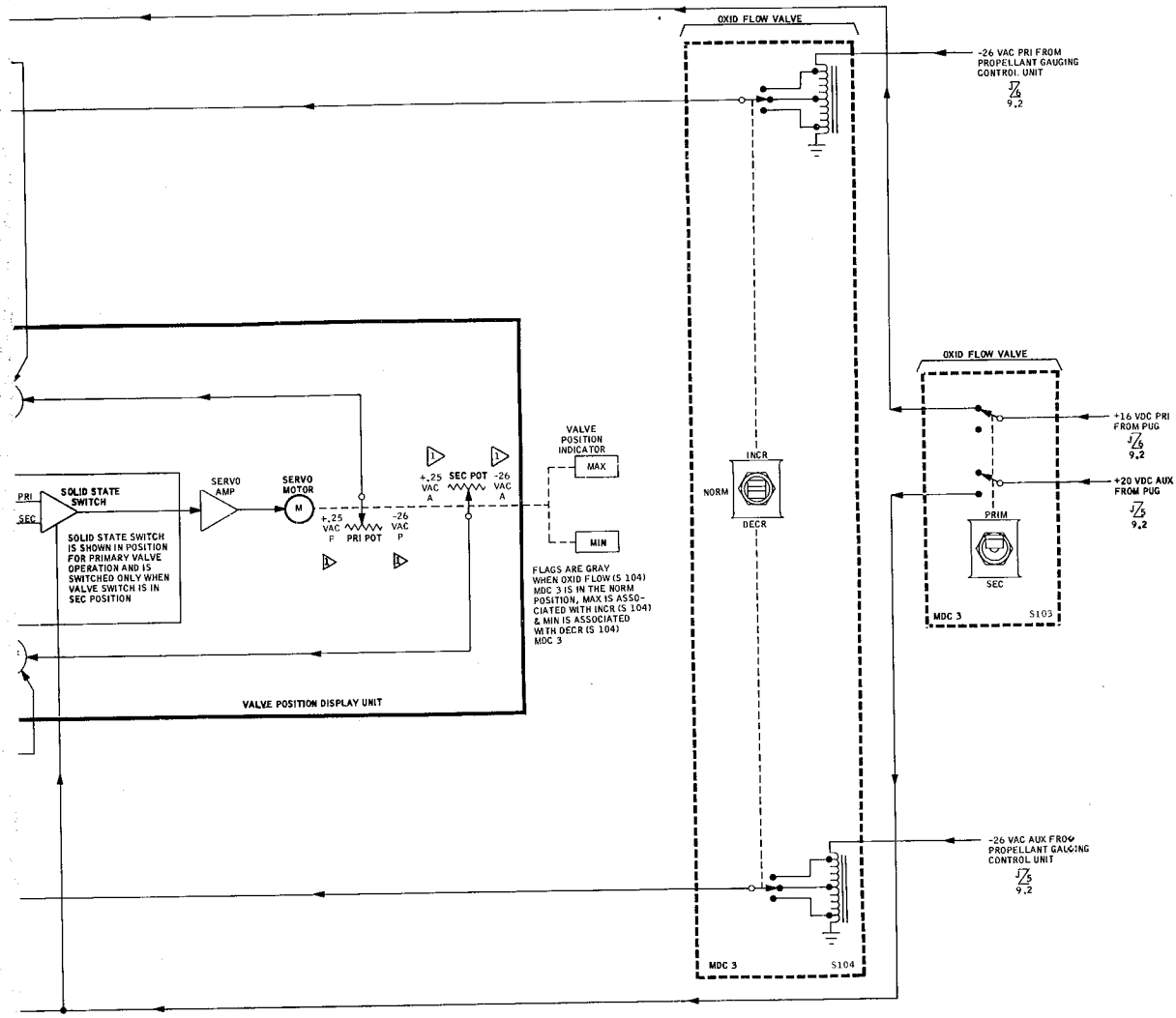


TEST INPUT NO 1 7

TEST INPUT NO 2 7


H
G
F
E
SM
CM
8
7
6
5
4
3
2
1
-.25 VAC A
SEC POT
+26 VAC A
SERVO MOTOR
M
-.25 VAC P
PRI POT
+26 VAC P
SERVO AMP
ΣV
TACH
PRIMARY PU VALVE CONTROL
STOP
PRI
SEC
FLOW AREA
SLIDING GATE VALVE
STOP
TACH
SERVO AMP
-.25 VAC A
SEC POT
+26 VAC A
-.25 VAC P
PRI POT
+26 VAC P
SERVO MOTOR
M
ΣV
SECONDARY PU VALVE CONTROL
PROPELLANT UTILIZATION VALVE

LTR	DR	ENGR	DATE	APPROVAL



NOTE: A - IS POWER FROM AUX POWER SUPPLY
P - IS POWER FROM PRI POWER SUPPLY

3 PRPLNT CNTL

SIGNATURES	DATE
DR	9-12-68
DSGN	
QC	9-13-68
ENGR	9/13/68
NR	10/1/68
ARE	10-27-68
FEC	11/7/68
AUTH	11-7-68

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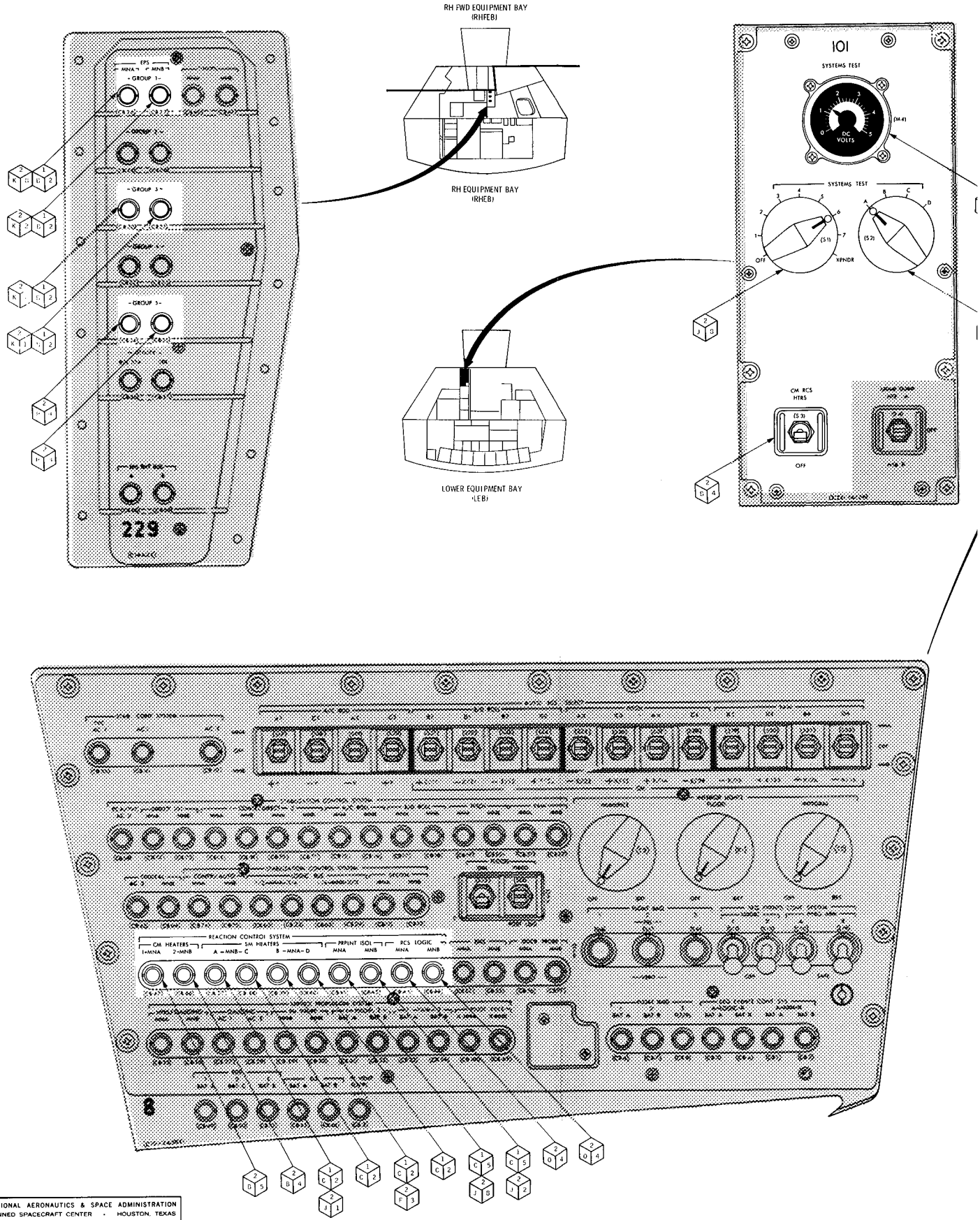
SPS PROPELLANT UTILIZATION VALVE CONTROL

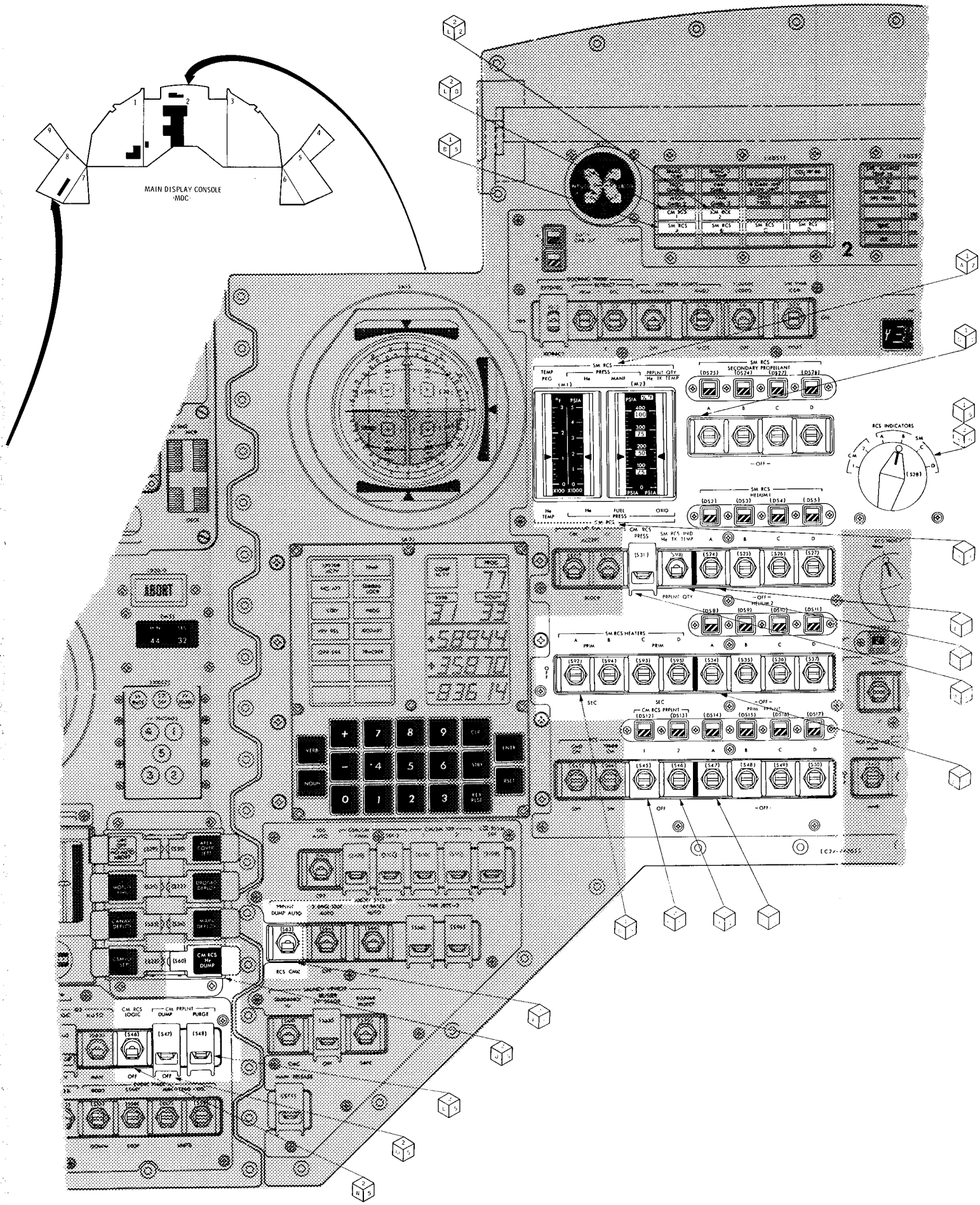
CSM	SIZE	DWG NO.
104	E	9.3

44 X 34 SHEET 1 OF 1

10 REACTION CONTROL SYSTEM



NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER · HOUSTON, TEXAS		
REACTION CONTROL SYSTEM CONTROL-DISPLAY FIGURE		
DWG NO. FIGURE 10.1	SIZE J	CSM 104
SHEET OF PAGE		50.5 X 34

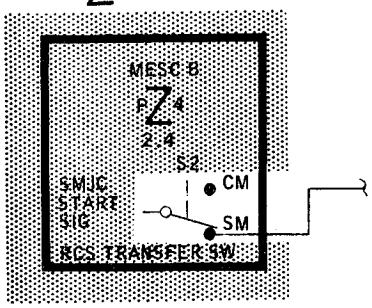

MAIN DISPLAY CONSOLE
(MDC)
SM RCS
SECONDARY PROPELLANT
RCS INDICATORS
SM RCS HELIUM 1
SM RCS HELIUM 2
SM RCS HEATERS
CM RCS PRPLNT
CM RCS PRESS
SM RCS IND
CM RCS LOGIC
CM PRPLNT DUMP
PURGE
CM RCS He DUMP
RCS CMC
VERB
NOUN
CLR
ENTR
RSET
KEY REL
STBY

IS

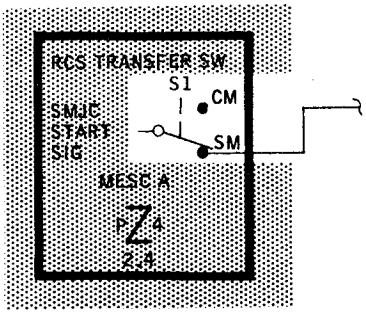
1. DWG 10.1 B,A Z 3

ENGINE LIFE 1000 SECONDS MIXED MODES
750 SECONDS CONTINUOUS CAPABILITY

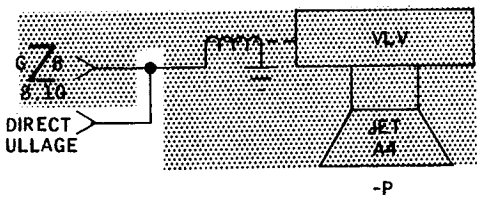
2. DWG 10.1 0 Z 5



3. DWG 10.1 0 Z 2

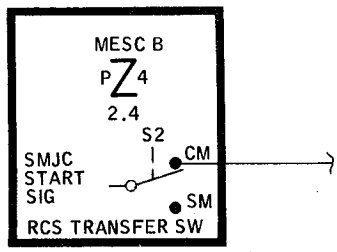


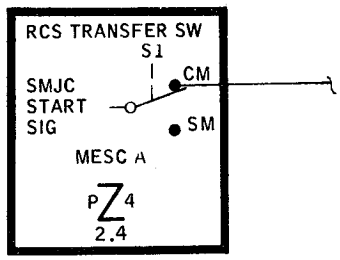
4. DWG 10.1 I Z 2

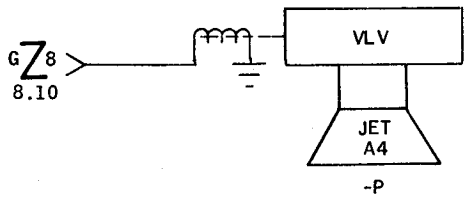


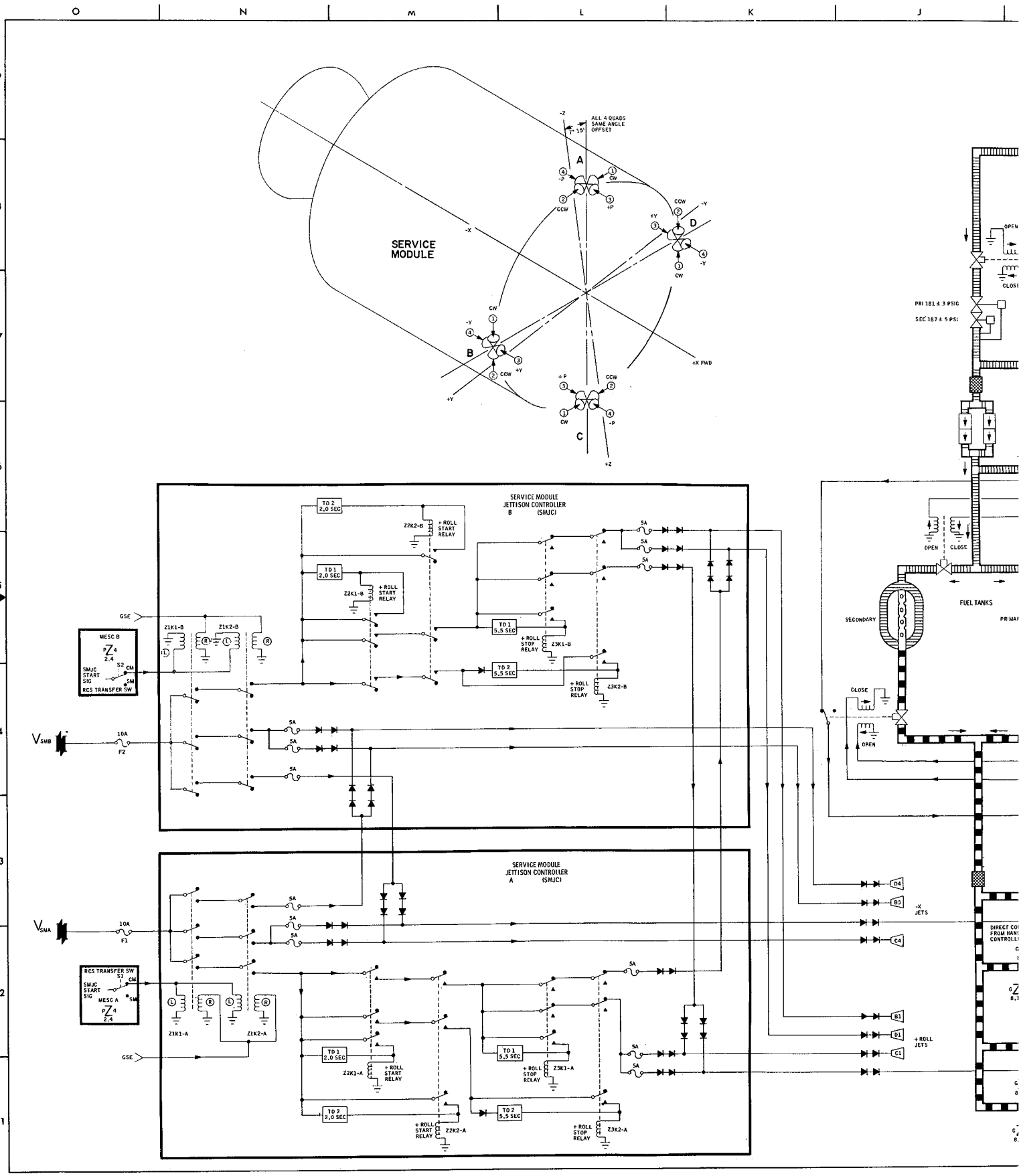
WAS

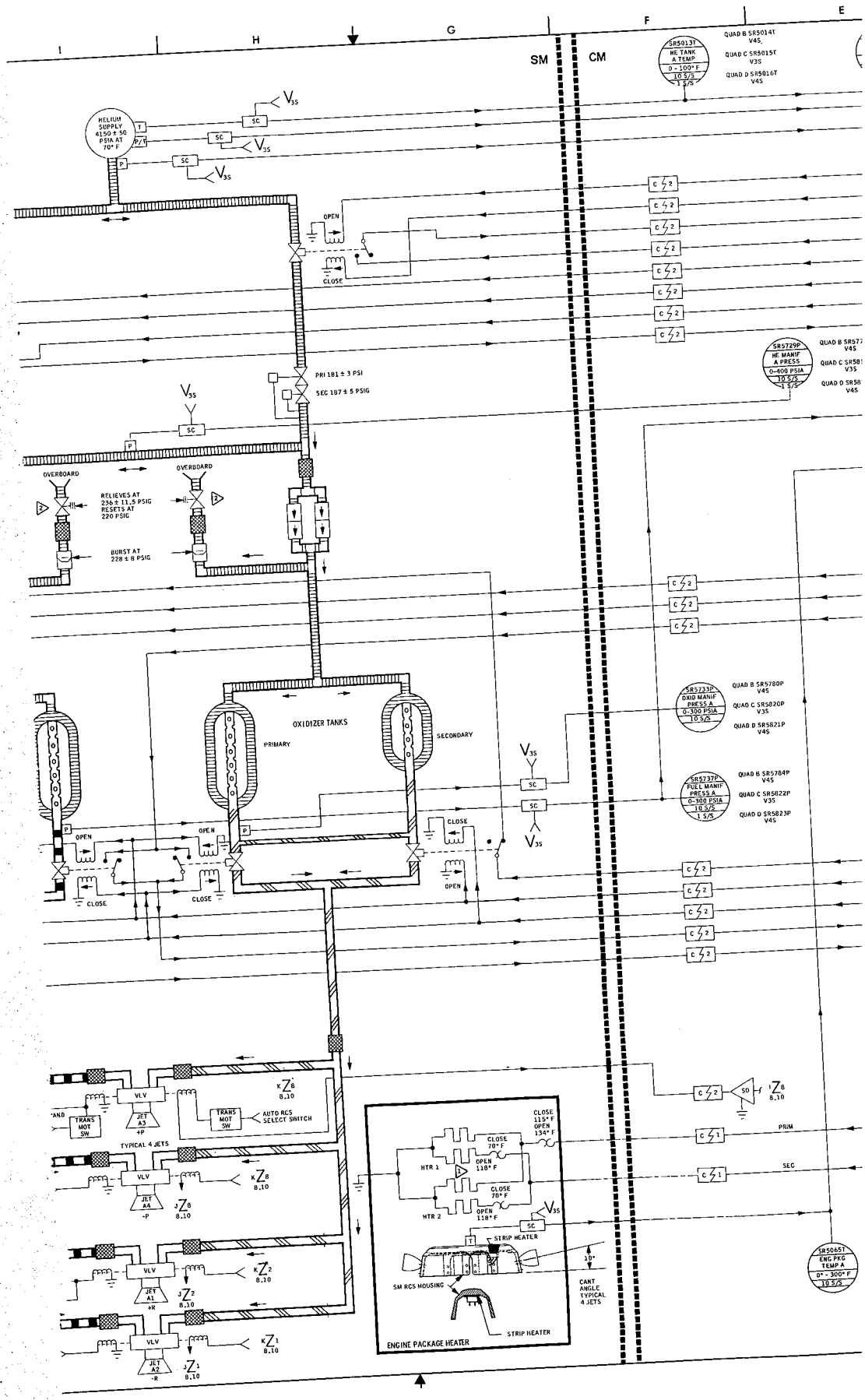
ENGINE LIFE 1000 SECONDS MIXED MODES
500 SECONDS CONTINUOUS CAPABILITY

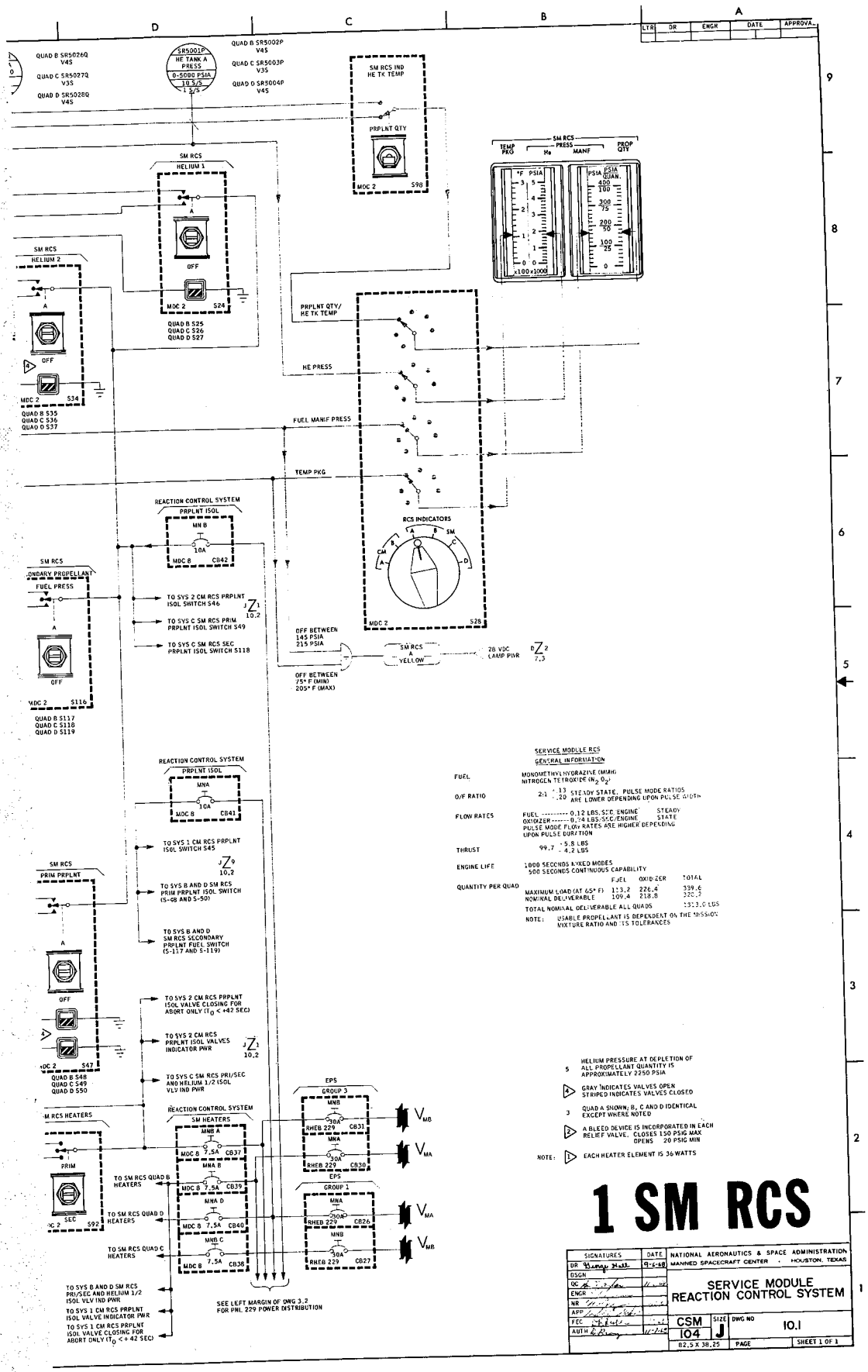







SERVICE MODULE
ALL 4 QUADS SAME ANGLE OFFSET
+ 15°
-Z
A
B
C
D
CW
CCW
-P
+P
-Y
+Y
-X
+X FWD
+Z
SERVICE MODULE JETTISON CONTROLLER B (SMJC)
SERVICE MODULE JETTISON CONTROLLER A (SMJC)
TD 1 2,0 SEC
TD 2 2,0 SEC
TD 1 5,5 SEC
TD 2 5,5 SEC
+ ROLL START RELAY
+ ROLL STOP RELAY
Z1K1-B
Z1K2-B
Z2K1-B
Z2K2-B
Z3K1-B
Z3K2-B
Z1K1-A
Z1K2-A
Z2K1-A
Z2K2-A
Z3K1-A
Z3K2-A
GSE
MESC B
MESC A
SMJC START SIG
RCS TRANSFER SW
S1
S2
CM
SM
P Z 4
2,4
V_{SMB}
V_{SMA}
10A
F2
F1
5A
D4
B3
C4
B1
D1
C1
-X JETS
+ ROLL JETS
FUEL TANKS
SECONDARY
PRIMARY
OPEN
CLOSE
PRI 181 ± 3 PSIG
SEC 187 ± 5 PSI


I
H
G
F
E
SM
CM
HELIUM SUPPLY 4150 ± 50 PSIA AT 70° F
SC
OPEN
CLOSE
PRI 181 ± 3 PSI
SEC 187 ± 5 PSIG
OVERBOARD
RELIEVES AT 235 ± 11.5 PSIG RESETS AT 220 PSIG
BURST AT 228 ± 8 PSIG
OXIDIZER TANKS
PRIMARY
SECONDARY
SR5013T HE TANK A TEMP 0 - 100° F 10 S/S 1 S/S
QUAD B SR5014T V4S
QUAD C SR5015T V3S
QUAD D SR5016T V4S
SR5729P HE MANIF A PRESS 0-400 PSIA 10 S/S 1 S/S
SR5733P OXID MANIF PRESS A 0-300 PSIA 10 S/S
QUAD B SR5780P V4S
QUAD C SR5820P V3S
QUAD D SR5821P V4S
SR5737P FUEL MANIF PRESS A 0-300 PSIA 10 S/S 1 S/S
QUAD B SR5784P V4S
QUAD C SR5822P V3S
QUAD D SR5823P V4S
VLV
JET A3 +P
JET A4 -P
JET A1 +R
JET A2 -R
TRANS MOT SW
AUTO RCS SELECT SWITCH
TYPICAL 4 JETS
HTR 1
HTR 2
CLOSE 70° F
OPEN 118° F
CLOSE 115° F
OPEN 134° F
STRIP HEATER
SM RCS HOUSING
10°
CANT ANGLE TYPICAL 4 JETS
ENGINE PACKAGE HEATER
PRIM
SEC
SR5065T ENG PKG TEMP A 0° - 300° F 10 S/S



SERVICE MODULE RCS
GENERAL INFORMATION

FUEL	MONOMETHYLHYDRAZINE (MMH) NITROGEN TETROXIDE (N_2O_4)
O/F RATIO	2:1 +.13 -.20 STEADY STATE. PULSE MODE RATIOS ARE LOWER DEPENDING UPON PULSE WIDTH
FLOW RATES	FUEL ---------- 0.12 LBS/SEC/ENGINE STEADY STATE OXIDIZER ------- 0.24 LBS/SEC/ENGINE PULSE MODE FLOW RATES ARE HIGHER DEPENDING UPON PULSE DURATION
THRUST	99.7 +5.8 -4.2 LBS
ENGINE LIFE	1000 SECONDS MIXED MODES 500 SECONDS CONTINUOUS CAPABILITY

QUANTITY PER QUAD

	FUEL	OXIDIZER	TOTAL
MAXIMUM LOAD (AT 65° F)	113.2	226.4	339.6
NOMINAL DELIVERABLE	109.4	218.8	328.2
TOTAL NOMINAL DELIVERABLE ALL QUADS			1313.0 LBS

NOTE: USABLE PROPELLANT IS DEPENDENT ON THE MISSION MIXTURE RATIO AND ITS TOLERANCES

5 HELIUM PRESSURE AT DEPLETION OF ALL PROPELLANT QUANTITY IS APPROXIMATELY 2250 PSIA

4 GRAY INDICATES VALVES OPEN STRIPED INDICATES VALVES CLOSED

3 QUAD A SHOWN; B, C AND D IDENTICAL EXCEPT WHERE NOTED

2 A BLEED DEVICE IS INCORPORATED IN EACH RELIEF VALVE. CLOSES 150 PSIG MAX OPENS 20 PSIG MIN

NOTE: 1 EACH HEATER ELEMENT IS 36 WATTS

1 SM RCS

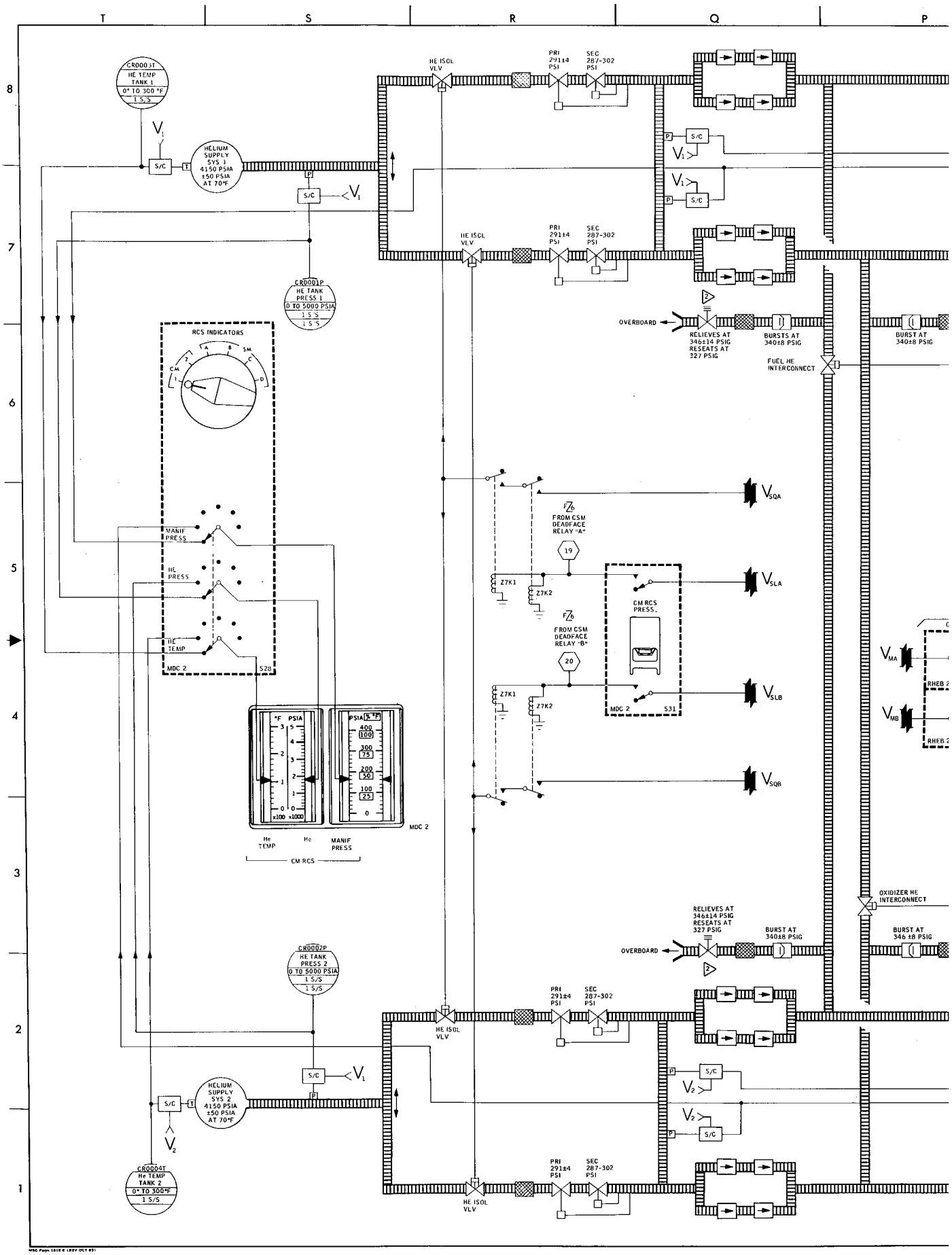
SIGNATURES	DATE
DR	9-6-68
DSGN	
QC	
ENGR	
NR	
APP	
FEC	
AUTH	11-7-68

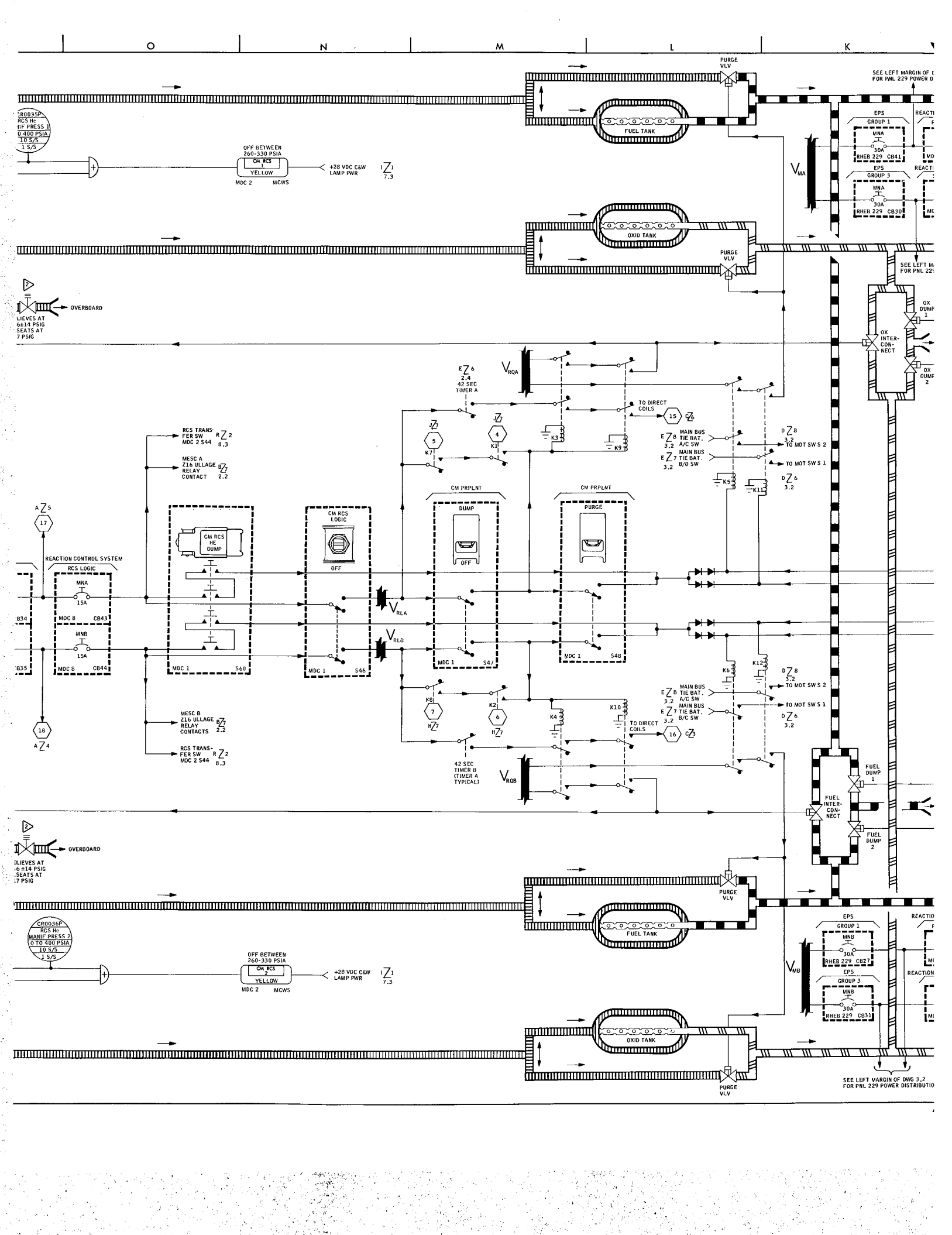
NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER . HOUSTON, TEXAS

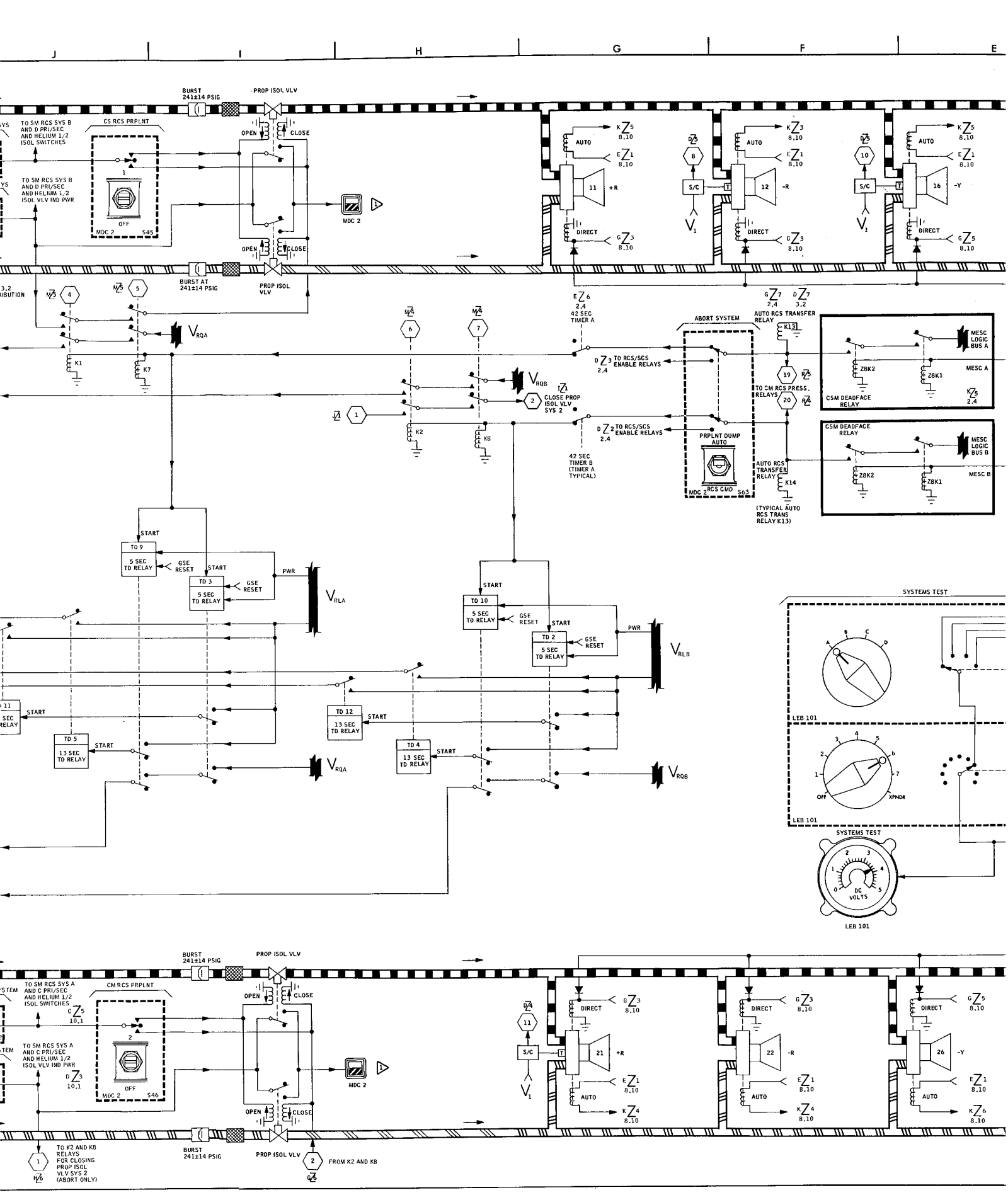
SERVICE MODULE REACTION CONTROL SYSTEM

CSM 104 | SIZE J | DWG NO 10.1

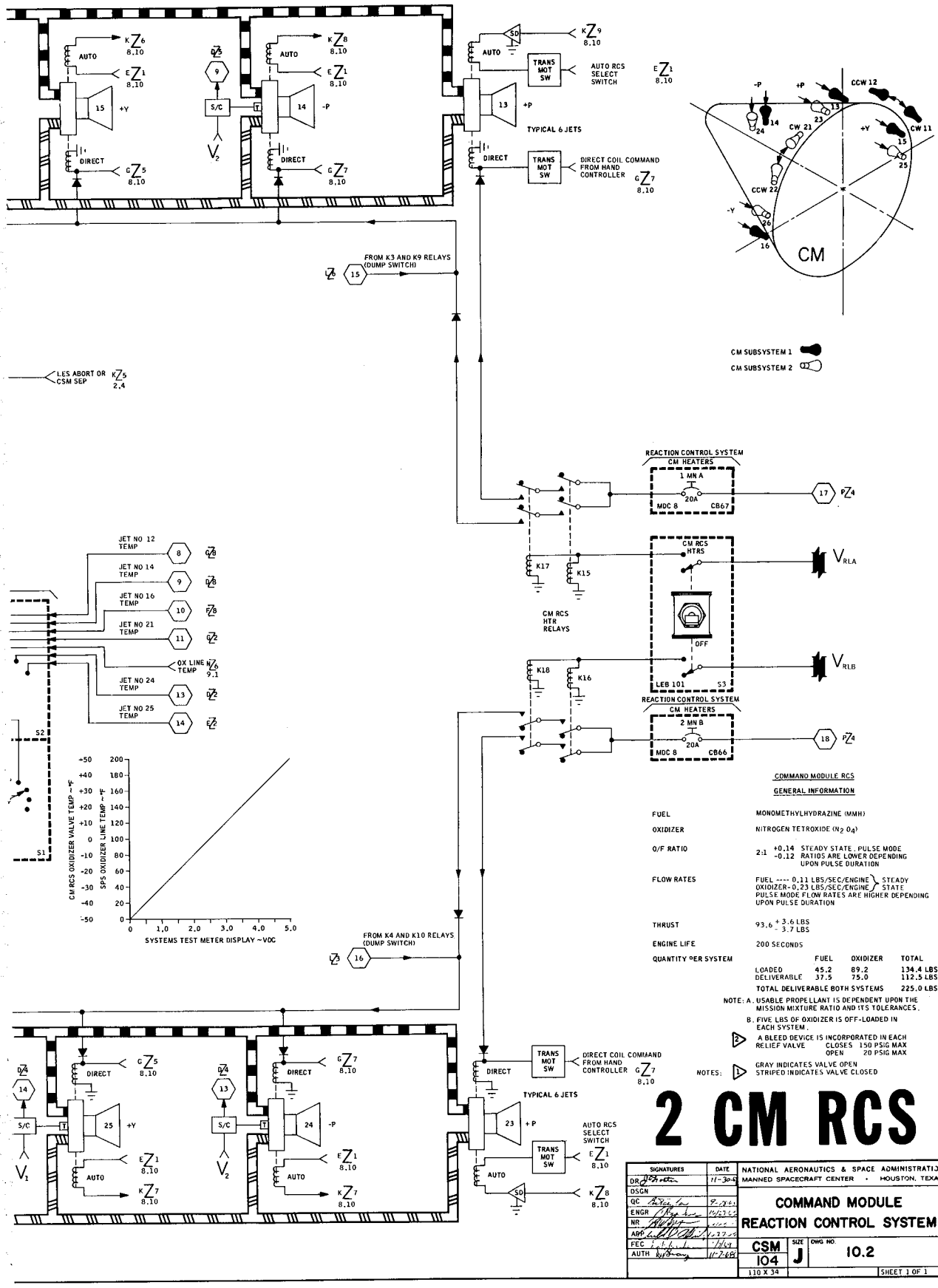
82.5 X 38.25 | PAGE | SHEET 1 OF 1


T
S
R
Q
P
8
7
6
5
4
3
2
1
CR0003T
HE TEMP TANK 1
0° TO 300 °F
1 S/S
HELIUM SUPPLY SYS 1 4150 PSIA ±50 PSIA AT 70°F
S/C
CR0001P
HE TANK PRESS 1
0 TO 5000 PSIA
1 S/S
HE ISOL VLV
PRI 291±4 PSI
SEC 287-302 PSI
OVERBOARD
RELIEVES AT 346±14 PSIG RESEATS AT 327 PSIG
BURSTS AT 340±8 PSIG
BURST AT 340±8 PSIG
FUEL HE INTERCONNECT
RCS INDICATORS
MANIF PRESS
HE PRESS
HE TEMP
MDC 2
S28
FROM CSM DEADFACE RELAY "A"
FROM CSM DEADFACE RELAY "B"
Z7K1
Z7K2
CM RCS PRESS.
S31
MDC 2
He TEMP
He
MANIF PRESS
CM RCS
OXIDIZER HE INTERCONNECT
CR0002P
HE TANK PRESS 2
0 TO 5000 PSIA
CR0004T
He TEMP TANK 2
0° TO 300°F
HELIUM SUPPLY SYS 2 4150 PSIA ±50 PSIA AT 70°F


O
N
M
L
K
PURGE VLV
FUEL TANK
OXID TANK
OVERBOARD
OFF BETWEEN 260-330 PSIA
CM RCS 1 YELLOW
MDC 2
MCWS
+28 VDC C&W LAMP PWR
EPS GROUP 1
EPS GROUP 3
MNA
MNB
30A
RHEB 229 CB41
RHEB 229 CB30
RHEB 229 CB27
RHEB 229 CB31
V_{MA}
V_{MB}
OX INTER-CON-NECT
OX DUMP 1
OX DUMP 2
FUEL INTER-CON-NECT
FUEL DUMP 1
FUEL DUMP 2
V_{RQA}
V_{RQB}
V_{RLA}
V_{RLB}
TO DIRECT COILS
MAIN BUS TIE BAT. A/C SW
MAIN BUS TIE BAT. B/D SW
TO MOT SW S 1
TO MOT SW S 2
42 SEC TIMER A
42 SEC TIMER B (TIMER A TYPICAL)
RCS TRANS-FER SW MDC 2 S44
MESC A Z16 ULLAGE RELAY CONTACT
MESC B Z16 ULLAGE RELAY CONTACTS
REACTION CONTROL SYSTEM
RCS LOGIC
CM RCS HE DUMP
CM RCS LOGIC
CM PRPLNT DUMP
CM PRPLNT PURGE
OFF
MDC 1 S60
MDC 1 S46
MDC 1 S47
MDC 1 S48
MDC 8 CB43
MDC 8 CB44
SEE LEFT MARGIN OF DWG 3.2 FOR PNL 229 POWER DISTRIBUTIO


J
I
H
G
F
E
BURST 241±14 PSIG
PROP ISOL VLV
CS RCS PRPLNT
TO SM RCS SYS B AND D PRI/SEC AND HELIUM 1/2 ISOL SWITCHES
TO SM RCS SYS B AND D PRI/SEC AND HELIUM 1/2 ISOL VLV IND PWR
OPEN
CLOSE
OFF
MDC 2
S45
AUTO
DIRECT
+R
-R
-Y
S/C
BURST AT 241±14 PSIG
PROP ISOL VLV
42 SEC TIMER A
ABORT SYSTEM
AUTO RCS TRANSFER RELAY
TO RCS/SCS ENABLE RELAYS
CLOSE PROP ISOL VLV SYS 2
42 SEC TIMER B (TIMER A TYPICAL)
PRPLNT DUMP AUTO
RCS CMD
S63
TO CM RCS PRESS. RELAYS
CSM DEADFACE RELAY
MESC LOGIC BUS A
MESC LOGIC BUS B
MESC A
MESC B
Z8K1
Z8K2
(TYPICAL AUTO RCS TRANS RELAY K13)
START
GSE RESET
PWR
TO 9
5 SEC TD RELAY
TO 3
TO 10
TO 2
TO 12
13 SEC TD RELAY
TO 5
TO 4
SYSTEMS TEST
LEB 101
XPNDR
DC VOLTS
CM RCS PRPLNT
TO SM RCS SYS A AND C PRI/SEC AND HELIUM 1/2 ISOL SWITCHES
TO SM RCS SYS A AND C PRI/SEC AND HELIUM 1/2 ISOL VLV IND PWR
S46
TO K2 AND K8 RELAYS FOR CLOSING PROP ISOL VLV SYS 2 (ABORT ONLY)
FROM K2 AND K8

LTR	DR	ENGR	DATE	APPROVAL



COMMAND MODULE RCS GENERAL INFORMATION

FUEL	MONOMETHYLHYDRAZINE (MMH)
OXIDIZER	NITROGEN TETROXIDE (N_2O_4)
O/F RATIO	2:1 +0.14 -0.12 STEADY STATE. PULSE MODE RATIOS ARE LOWER DEPENDING UPON PULSE DURATION
FLOW RATES	FUEL ---- 0.11 LBS/SEC/ENGINE } STEADY STATE OXIDIZER- 0.23 LBS/SEC/ENGINE } PULSE MODE FLOW RATES ARE HIGHER DEPENDING UPON PULSE DURATION
THRUST	93.6 +3.6 -3.7 LBS
ENGINE LIFE	200 SECONDS

QUANTITY PER SYSTEM

	FUEL	OXIDIZER	TOTAL
LOADED	45.2	89.2	134.4 LBS
DELIVERABLE	37.5	75.0	112.5 LBS
TOTAL DELIVERABLE BOTH SYSTEMS			225.0 LBS

NOTE: A. USABLE PROPELLANT IS DEPENDENT UPON THE MISSION MIXTURE RATIO AND ITS TOLERANCES.

B. FIVE LBS OF OXIDIZER IS OFF-LOADED IN EACH SYSTEM.

NOTES: ③ A BLEED DEVICE IS INCORPORATED IN EACH RELIEF VALVE CLOSES 150 PSIG MAX OPEN 20 PSIG MAX

▷ GRAY INDICATES VALVE OPEN STRIPED INDICATES VALVE CLOSED

2 CM RCS

SIGNATURES	DATE
DR	11-30-67
DSGN	
QC	9-[illegible]-67
ENGR	11/27/67
NR	[illegible]
APP	11-27-67
FEC	11/29/67
AUTH	11-29-67

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER • HOUSTON, TEXAS

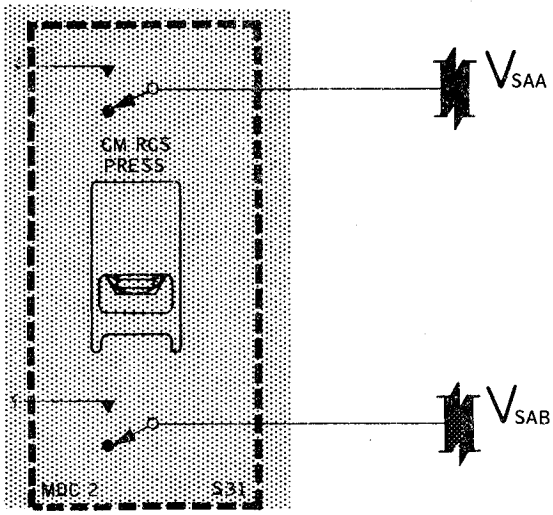
COMMAND MODULE REACTION CONTROL SYSTEM

CSM	SIZE	DWG NO.
104	J	10.2

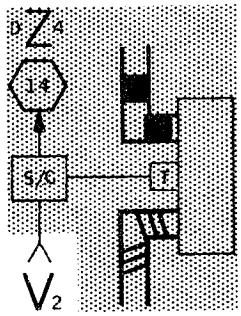
110 X 34 SHEET 1 OF 1

IS

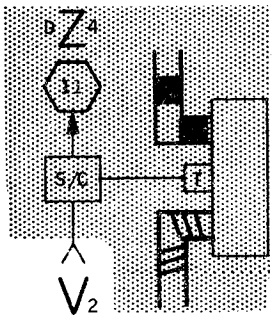
1. DWG 10.2 Q Z 5,4



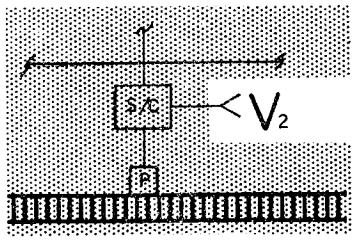
2. DWG 10.2 E Z 2,1



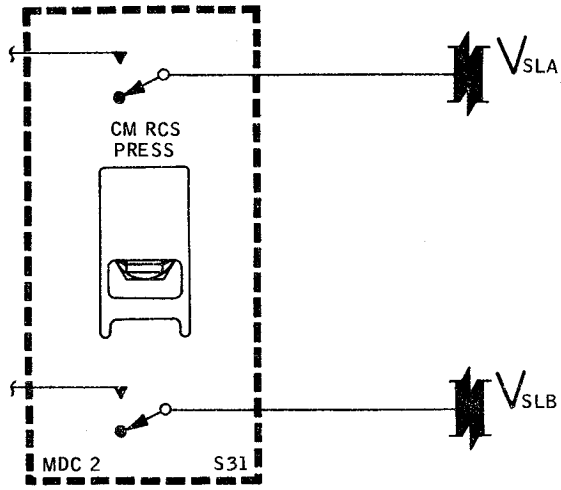
3. DWG 10.2 H Z 2,1

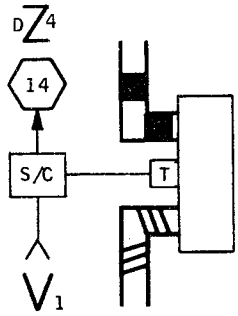


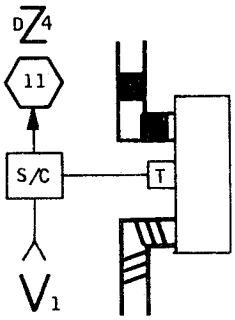
4. DWG 10.2 S Z 2

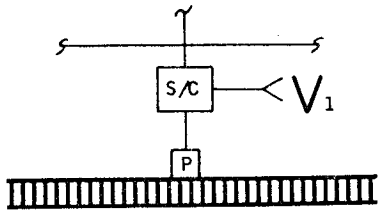


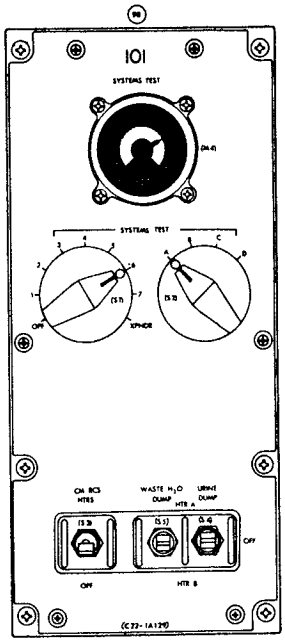
WAS

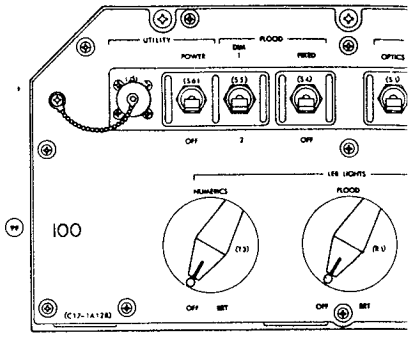


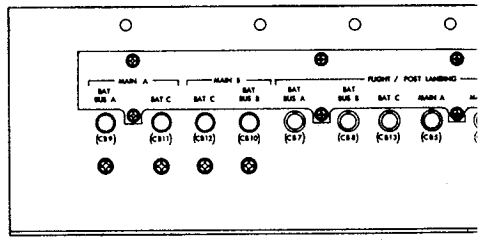


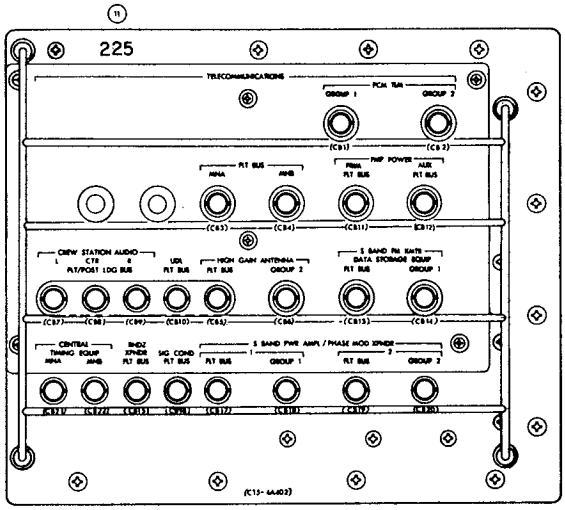


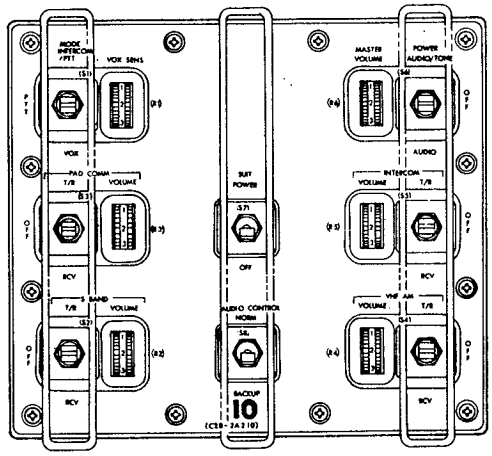


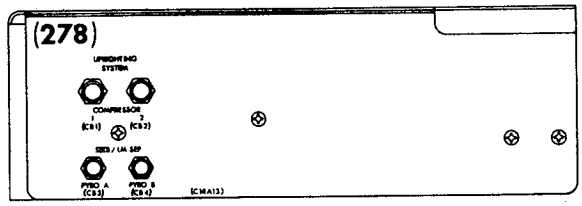




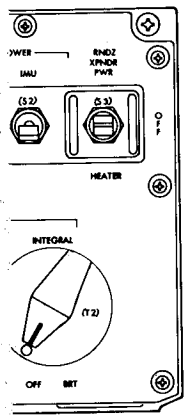


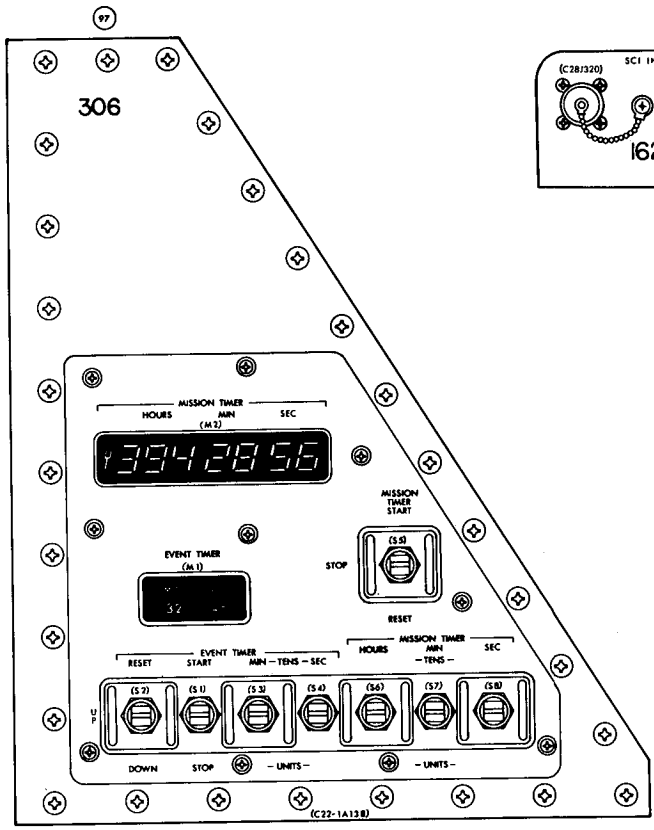


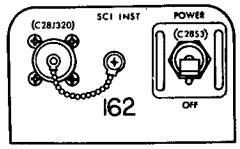


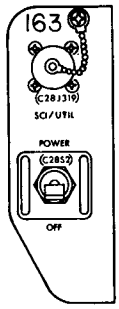


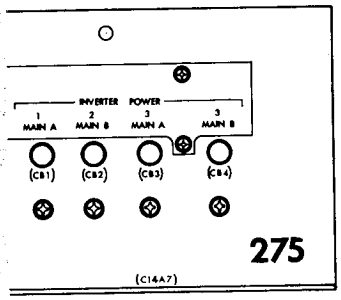
NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER - HOUSTON, TEXAS		
CONTROL DISPLAY FIGURE		
DWG NO 11.1A	SIZE J	
SHEET OF	PAGE	

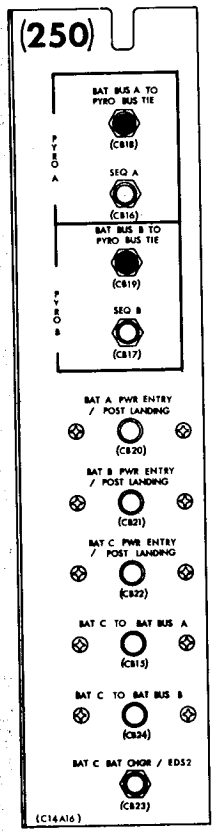

RNDZ XPNDR PWR
(S2)
(S3)
OFF
HEATER
INTEGRAL
(T2)
OFF
BIT

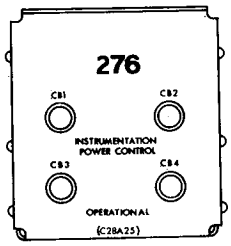

97
306
MISSION TIMER
HOURS
MIN
SEC
(M2)
EVENT TIMER
(M1)
MISSION TIMER START
(S5)
STOP
RESET
EVENT TIMER
RESET
START
MIN — TENS — SEC
MISSION TIMER
HOURS
MIN
SEC
— TENS —
(S7)
(S1)
(S3)
(S4)
(S6)
(S7)
(S8)
UP
DOWN
STOP
— UNITS —
— UNITS —
(C22-1A13B)

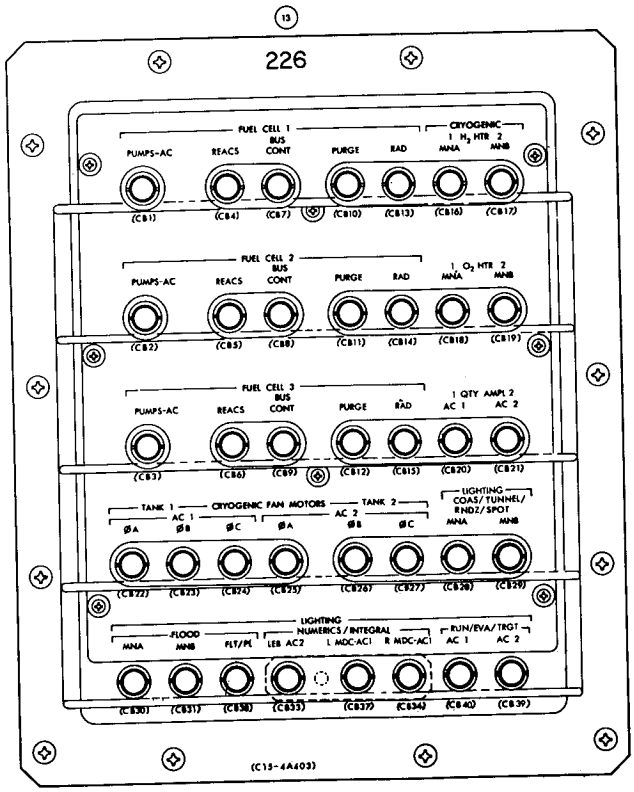

(C28J320)
SCI INST
POWER
(C28J3)
OFF
162

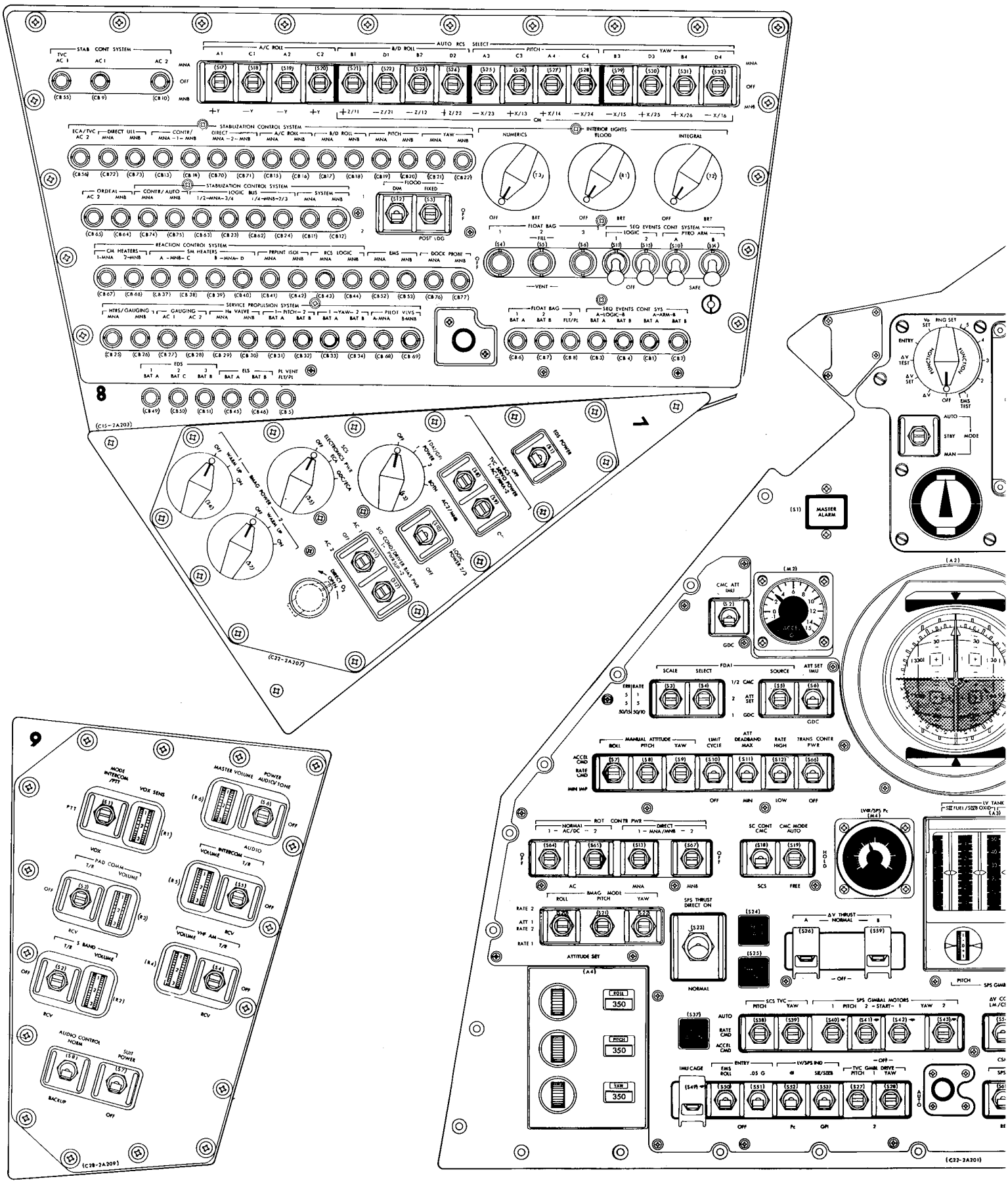

163
(C28J319)
SCI/UTIL
POWER
(C28J2)
OFF

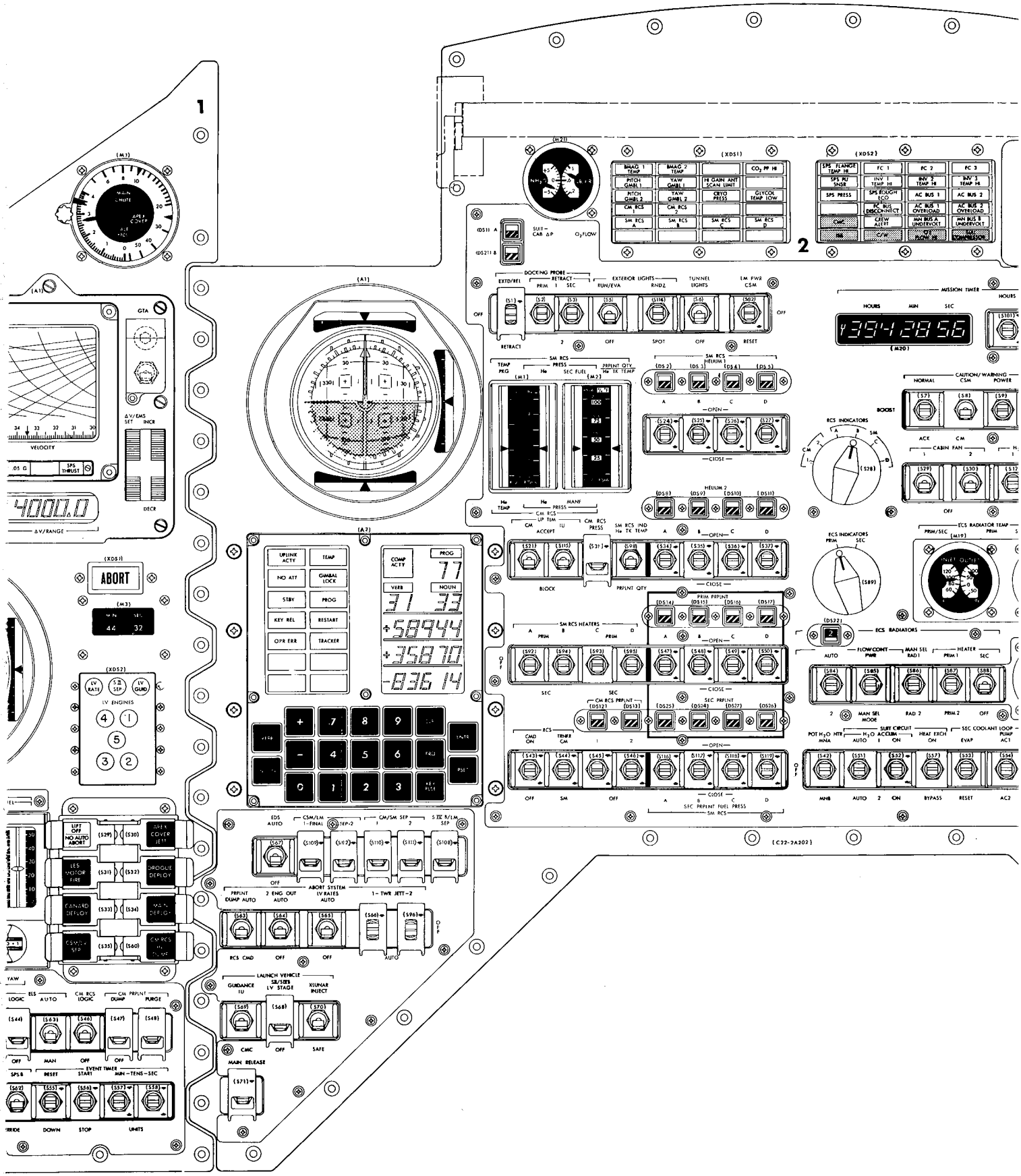

INVERTER POWER
1 MAIN A
2 MAIN B
3 MAIN A
3 MAIN B
(CB1)
(CB2)
(CB3)
(CB4)
275
(C14A7)

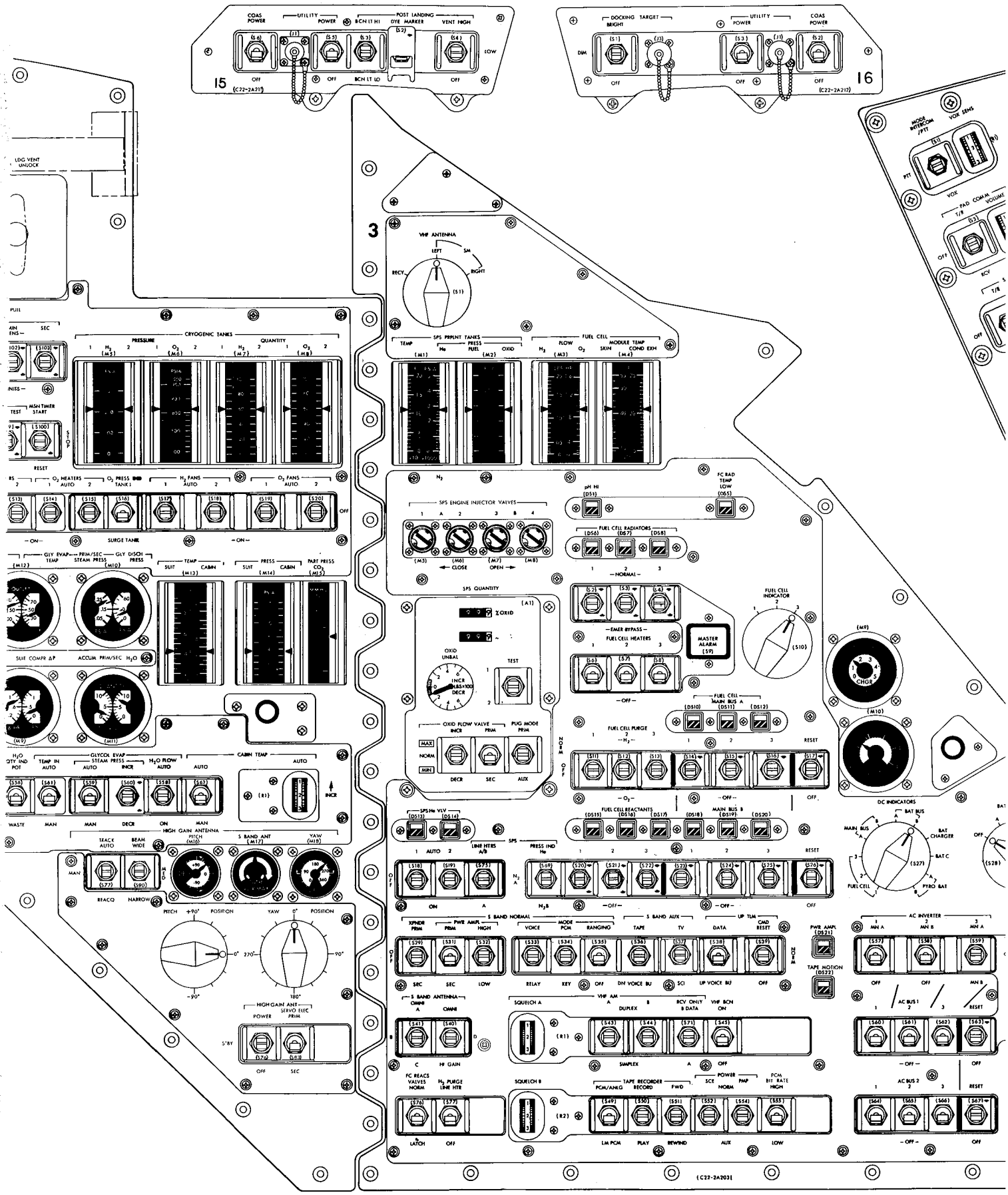

(250)
PYRO A
BAT BUS A TO PYRO BUS TIE
(CB18)
SEQ A
(CB16)
PYRO B
BAT BUS B TO PYRO BUS TIE
(CB19)
SEQ B
(CB17)
BAT A PWR ENTRY / POST LANDING
(CB20)
BAT B PWR ENTRY / POST LANDING
(CB21)
BAT C PWR ENTRY / POST LANDING
(CB22)
BAT C TO BAT BUS A
(CB15)
BAT C TO BAT BUS B
(CB24)
BAT C BAT CHGR / EDS2
(CB23)
(C14A16)

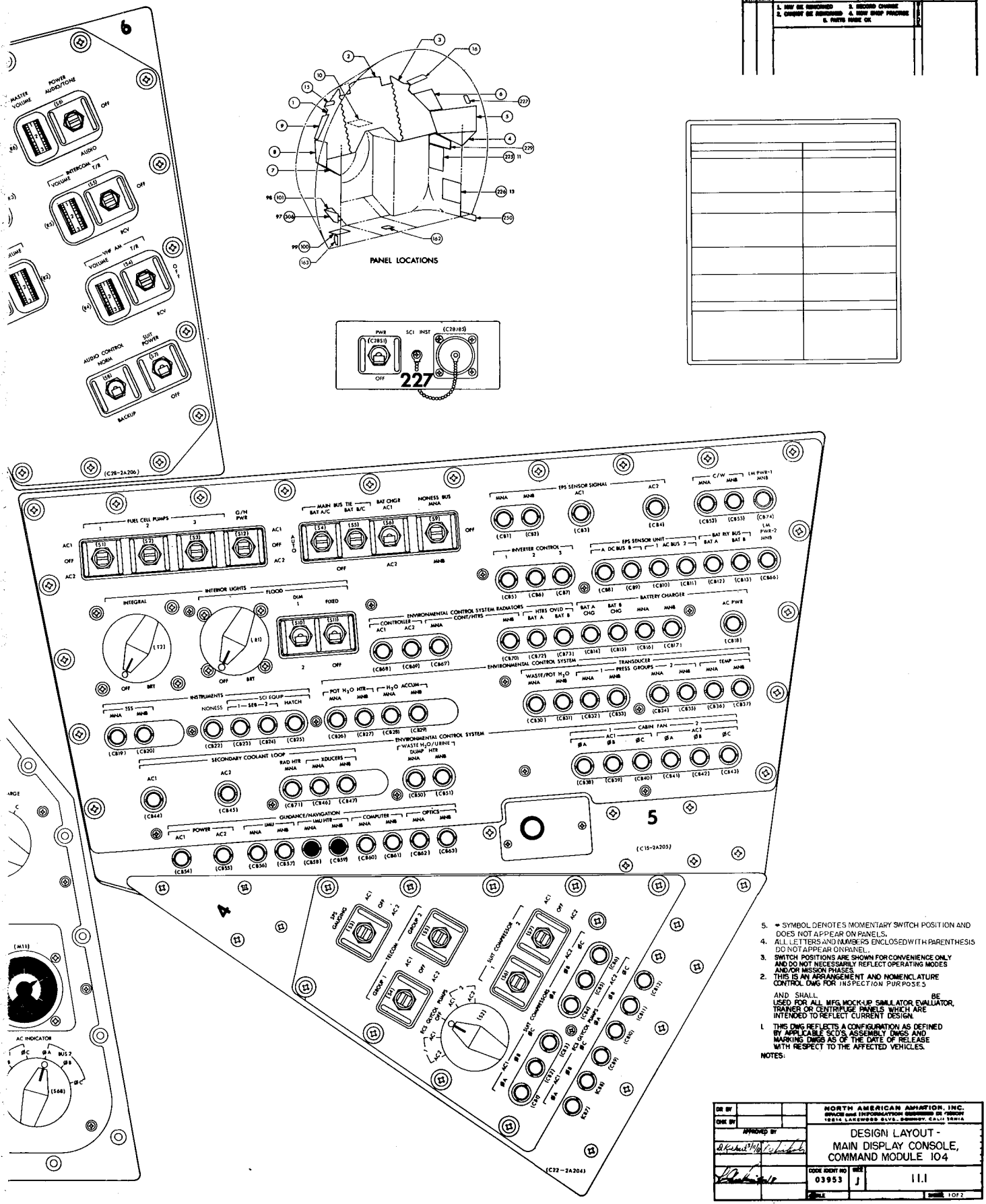

276
CB1
CB2
INSTRUMENTATION POWER CONTROL
CB3
CB4
OPERATIONAL
(C28A25)


13
226
FUEL CELL 1
PUMPS-AC
REACS
BUS CONT
PURGE
RAD
CRYOGENIC
1 H2 HTR 2
MNA
MNB
(CB1)
(CB4)
(CB7)
(CB10)
(CB13)
(CB16)
(CB17)
FUEL CELL 2
PUMPS-AC
REACS
BUS CONT
PURGE
RAD
1 O2 HTR 2
MNA
MNB
(CB2)
(CB5)
(CB8)
(CB11)
(CB14)
(CB18)
(CB19)
FUEL CELL 3
PUMPS-AC
REACS
BUS CONT
PURGE
RAD
1 QTY AMPL 2
AC 1
AC 2
(CB3)
(CB6)
(CB9)
(CB12)
(CB15)
(CB20)
(CB21)
TANK 1
CRYOGENIC FAN MOTORS
TANK 2
AC 1
AC 2
LIGHTING COAS/TUNNEL/ RNDZ/SPOT
ØA
ØB
ØC
ØA
ØB
ØC
MNA
MNB
(CB22)
(CB23)
(CB24)
(CB25)
(CB26)
(CB27)
(CB28)
(CB29)
LIGHTING
FLOOD
MNA
MNB
FLT/PL
NUMERICS / INTEGRAL
LEB AC2
L MDC-AC1
R MDC-AC1
RUN/EVA/TRGT
AC 1
AC 2
(CB30)
(CB31)
(CB32)
(CB33)
(CB37)
(CB34)
(CB40)
(CB39)
(C13-4A603)


STAB CONT SYSTEM
AUTO RCS SELECT
A/C ROLL
B/D ROLL
PITCH
YAW
STABILIZATION CONTROL SYSTEM
INTERIOR LIGHTS
FLOOD
INTEGRAL
NUMERICS
REACTION CONTROL SYSTEM
SERVICE PROPULSION SYSTEM
EDS
ELS
8
9
7
(C15-2A203)
(C22-2A207)
(C28-2A209)
(C22-2A201)
MASTER ALARM
MODE INTERCOM /PTT
VOX SENS
MASTER VOLUME
POWER AUDIO/TONE
PAD COMM
AUDIO CONTROL
SUIT POWER
BACKUP
SCS POWER
LOGIC POWER
ATTITUDE SET
SPS THRUST DIRECT ON
ΔV THRUST
SCS TVC
SPS GIMBAL MOTORS
IMU CAGE
LV/SPS IND
TVC GIMBAL DRIVE
ROLL
PITCH
YAW
350


1
2
ABORT
UPLINK ACTY
TEMP
NO ATT
GIMBAL LOCK
STBY
PROG
KEY REL
RESTART
OPR ERR
TRACKER
COMP ACTY
PROG
VERB
NOUN
77
31
33
+58944
+35870
-03614
MISSION TIMER
HOURS
MIN
SEC
CAUTION/WARNING
RCS INDICATORS
RCS RADIATORS
ECS RADIATOR TEMP
SM RCS HEATERS
CM RCS HEATERS
SM RCS HELIUM 1
SM RCS HELIUM 2
DOCKING PROBE
EXTERIOR LIGHTS
TUNNEL LIGHTS
LM PWR CSM
SUIT CIRCUIT
SEC COOLANT LOOP
EVENT TIMER
LAUNCH VEHICLE
ABORT SYSTEM
EDS
CSM/LM
CM/SM SEP
S IVB R/LM SEP
VELOCITY
ΔV/RANGE
ΔV/EMS SET
LV ENGINES
MAIN RELEASE
C22-2A202


15
COAS POWER
UTILITY POWER
POST LANDING DYE MARKER
BCN LT HI
VENT HIGH
BCN LT LO
LOW
OFF
(C22-2A211)
16
DOCKING TARGET BRIGHT
DIM
UTILITY POWER
COAS POWER
(C22-2A212)
3
VHF ANTENNA
LEFT
SM
RIGHT
RECV
SPS PROPLNT TANKS TEMP
FUEL CELL MODULE TEMP SKIN
COND EXH
CRYOGENIC TANKS
PRESSURE
QUANTITY
SURGE TANK
SPS ENGINE INJECTOR VALVES
FUEL CELL RADIATORS
FUEL CELL HEATERS
MASTER ALARM
FUEL CELL INDICATOR
SPS QUANTITY
OXID UNBAL
TEST
OXID FLOW VALVE
PLUG MODE
FUEL CELL PURGE
FUEL CELL REACTANTS
MAIN BUS A
MAIN BUS B
DC INDICATORS
BAT CHARGER
BAT C
PYRO BAT
FUEL CELL
MAIN BUS
CABIN TEMP
GLYCOL EVAP
HIGH GAIN ANTENNA
S BAND ANT
YAW
PITCH
POSITION
S BAND NORMAL
S BAND AUX
UP TLM
PWR AMPL
TAPE MOTION
AC INVERTER
S BAND ANTENNA
OMNI
HI GAIN
VHF AM
SQUELCH A
SQUELCH B
SIMPLEX
DUPLEX
TAPE RECORDER
PCM/ANLG
LM PCM
PLAY
REWIND
AUX
LOW
(C22-2A203)

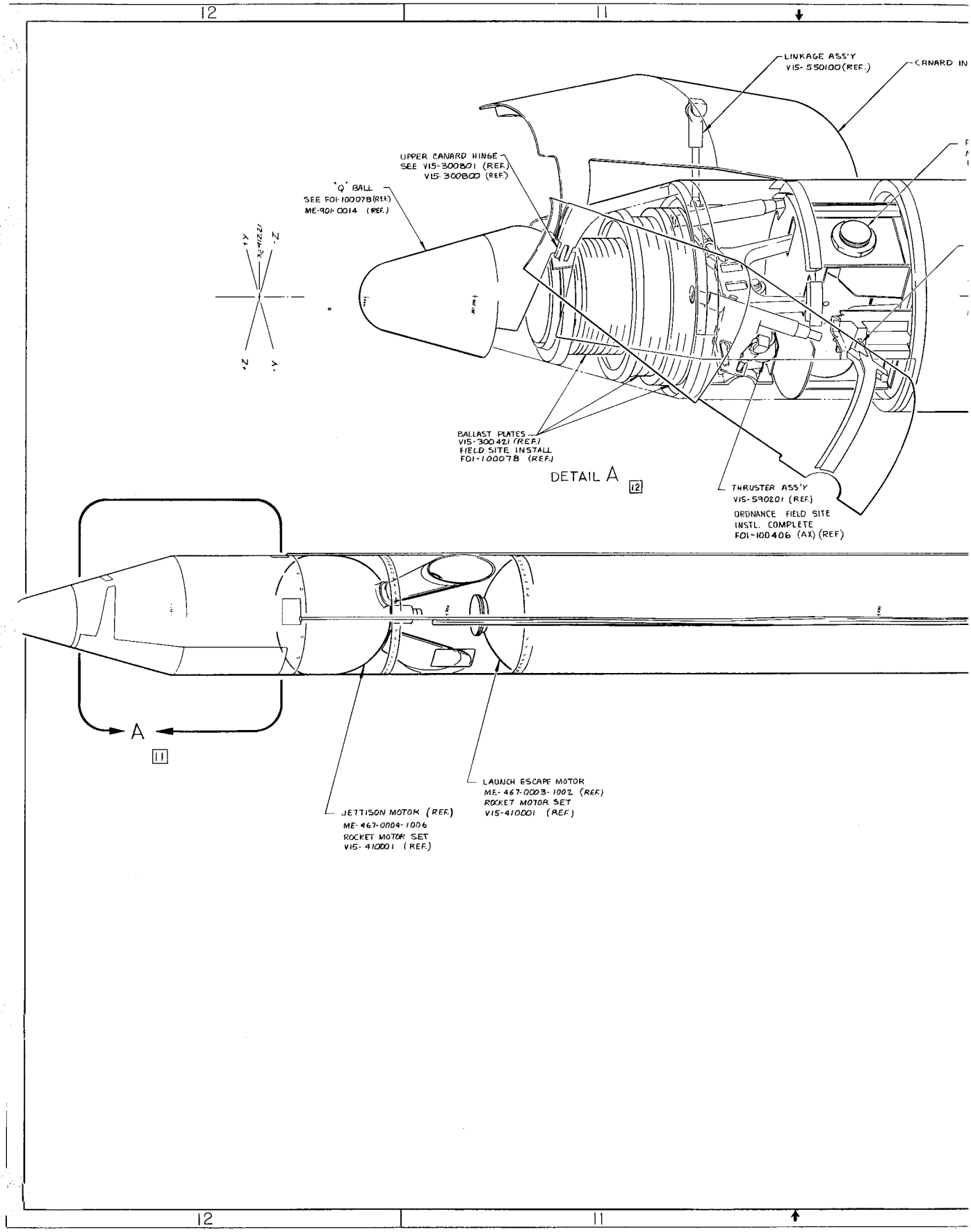


REVISIONS			
SYM	ZONE	DESCRIPTION	DATE / APPROVED
		1. MAY BE REMOVED 3. RECORD CHANGE 2. CHANGE NOT REQUIRED 4. MAY SHIP PRACTICE 5. PARTS MADE OK	

5. * SYMBOL DENOTES MOMENTARY SWITCH POSITION AND DOES NOT APPEAR ON PANELS.
4. ALL LETTERS AND NUMBERS ENCLOSED WITH PARENTHESIS DO NOT APPEAR ON PANEL.
3. SWITCH POSITIONS ARE SHOWN FOR CONVENIENCE ONLY AND DO NOT NECESSARILY REFLECT OPERATING MODES AND/OR MISSION PHASES.
2. THIS IS AN ARRANGEMENT AND NOMENCLATURE CONTROL DWG FOR INSPECTION PURPOSES AND SHALL BE USED FOR ALL MFG. MOCKUP, SIMULATOR, EVALUATOR, TRAINER OR CENTRIFUGE PANELS WHICH ARE INTENDED TO REFLECT CURRENT DESIGN.
1. THIS DWG REFLECTS A CONFIGURATION AS DEFINED BY APPLICABLE SCD'S, ASSEMBLY DWGS AND MARKING DWGS AS OF THE DATE OF RELEASE WITH RESPECT TO THE AFFECTED VEHICLES.

NOTES:

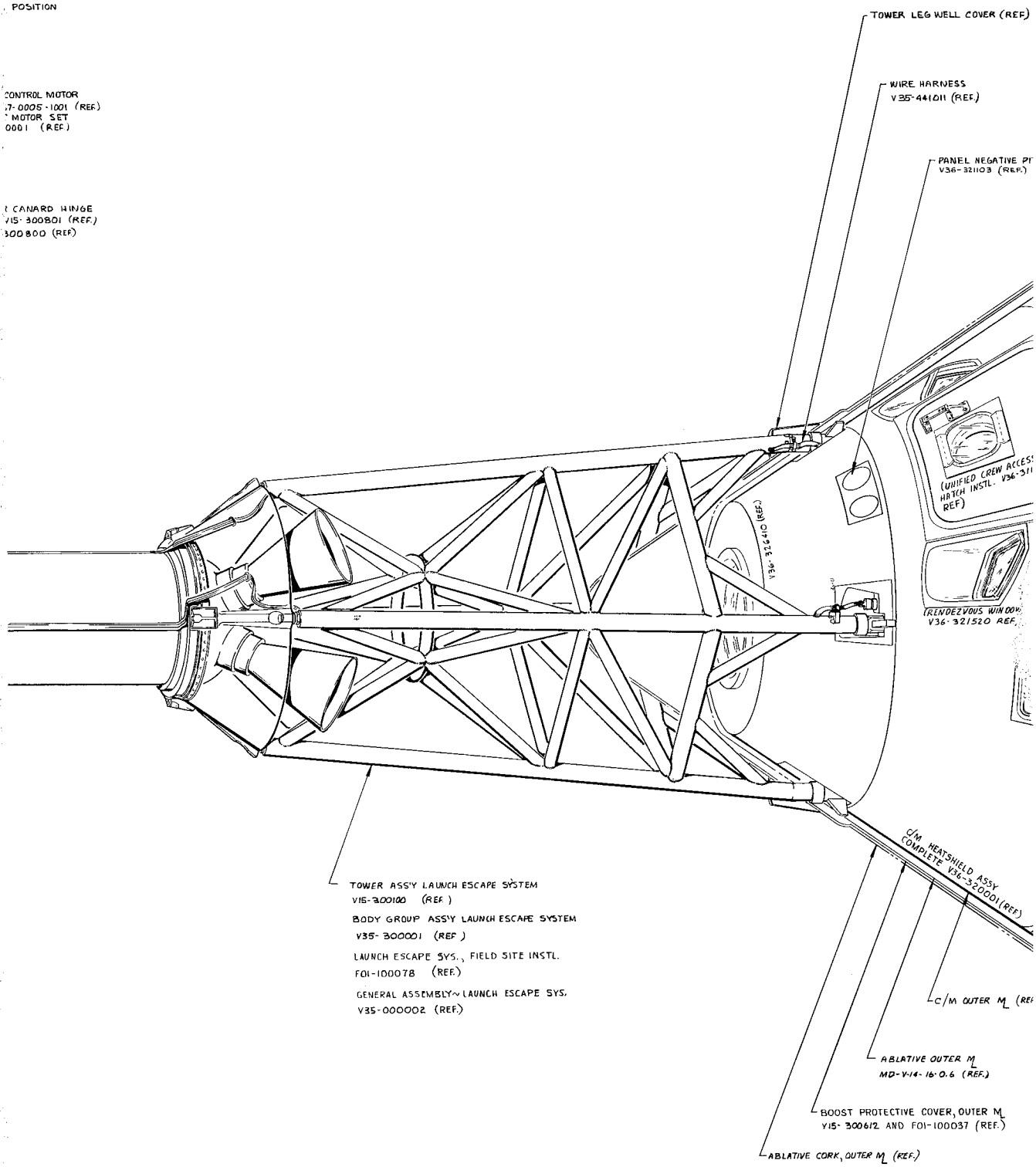
DR BY		NORTH AMERICAN AVIATION, INC. SPACE and INFORMATION SYSTEMS DIVISION 12214 LAKEWOOD BLVD., DOWNEY, CALIF.
CHK BY		
APPROVED BY		DESIGN LAYOUT - MAIN DISPLAY CONSOLE, COMMAND MODULE 104
	CODE IDENT NO 03953	SIZE J — 11.1
	SCALE	SHEET 1 OF 2


12
11
LINKAGE ASS'Y
V15-550100(REF.)
CANARD IN
UPPER CANARD HINGE
SEE V15-300801 (REF.)
V15-300800 (REF.)
'Q' BALL
SEE FOI-100078(REF)
ME-901-0014 (REF.)
+Y
+X
-Z
+Z
-Y
BALLAST PLATES
V15-300421 (REF.)
FIELD SITE INSTALL
FOI-100078 (REF.)
DETAIL A
12
THRUSTER ASS'Y
V15-590201 (REF.)
ORDNANCE FIELD SITE
INSTL. COMPLETE
FOI-100406 (AX) (REF)
A
11
JETTISON MOTOR (REF.)
ME-467-0004-1006
ROCKET MOTOR SET
V15-410001 (REF.)
LAUNCH ESCAPE MOTOR
ME-467-0003-1002 (REF.)
ROCKET MOTOR SET
V15-410001 (REF.)
12
11

POSITION

CONTROL MOTOR
7-0005-1001 (REF.)
MOTOR SET
0001 (REF.)

CANARD HINGE
V15-300801 (REF.)
300800 (REF.)

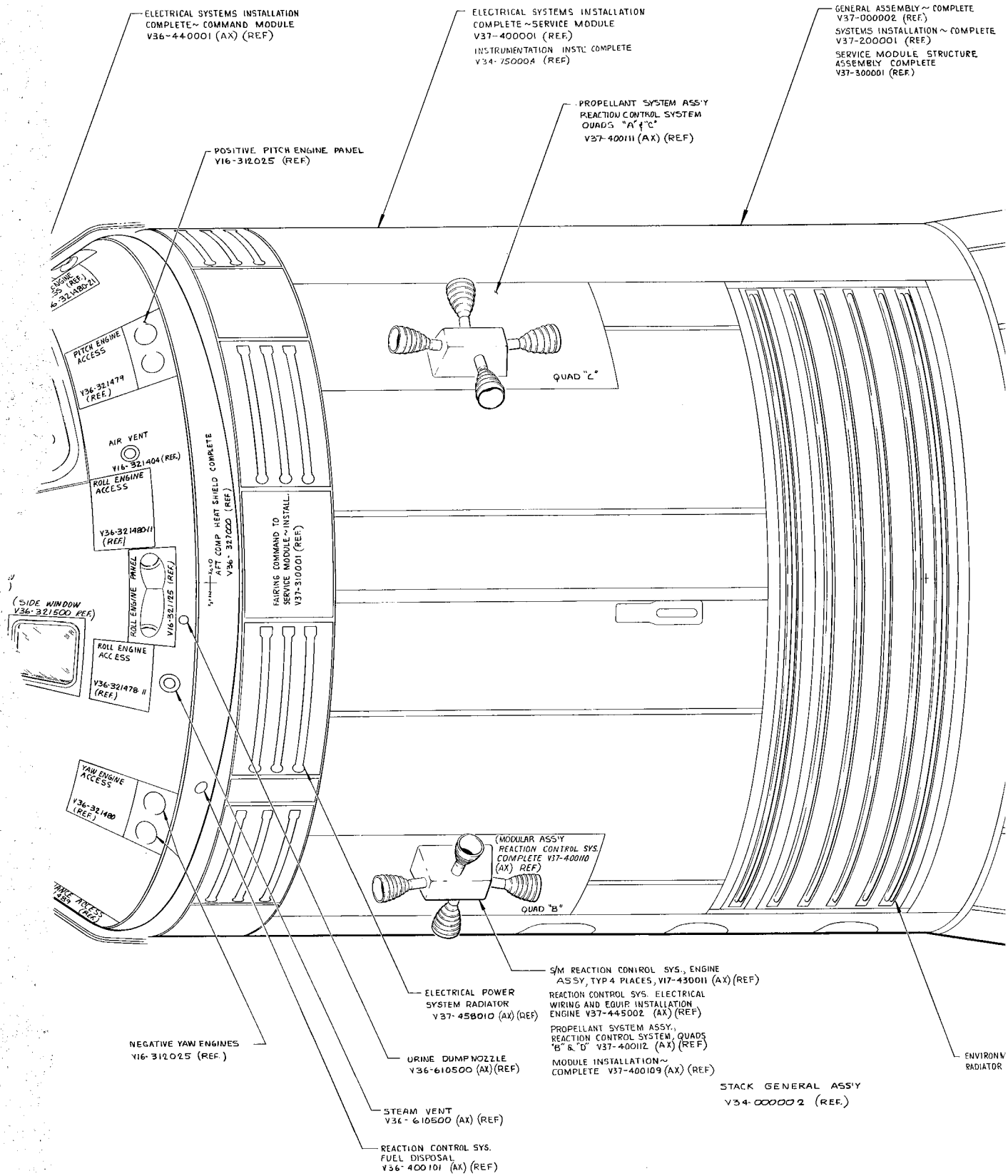


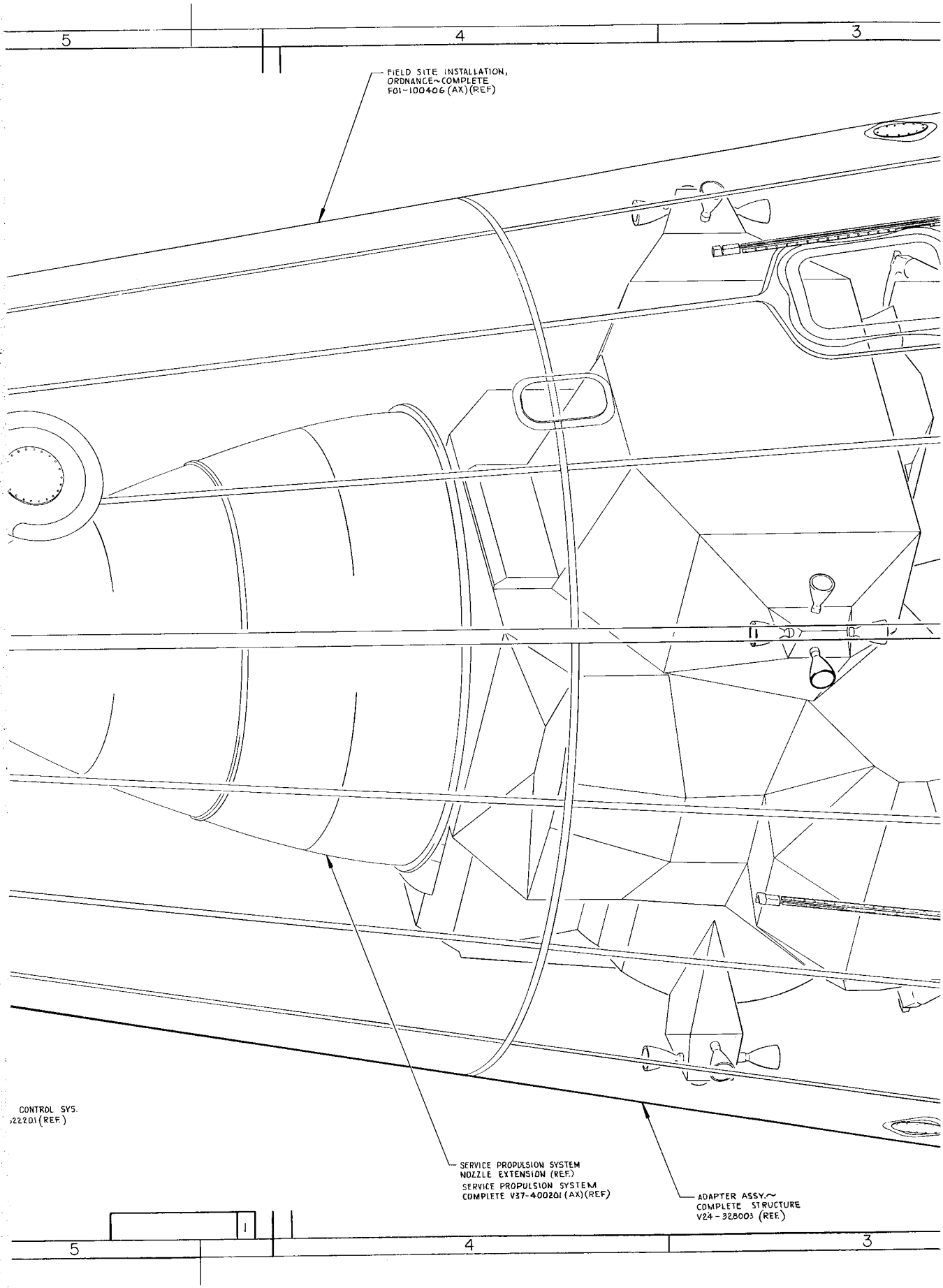
TOWER ASS'Y LAUNCH ESCAPE SYSTEM
V15-300100 (REF.)

BODY GROUP ASS'Y LAUNCH ESCAPE SYSTEM
V35-300001 (REF.)

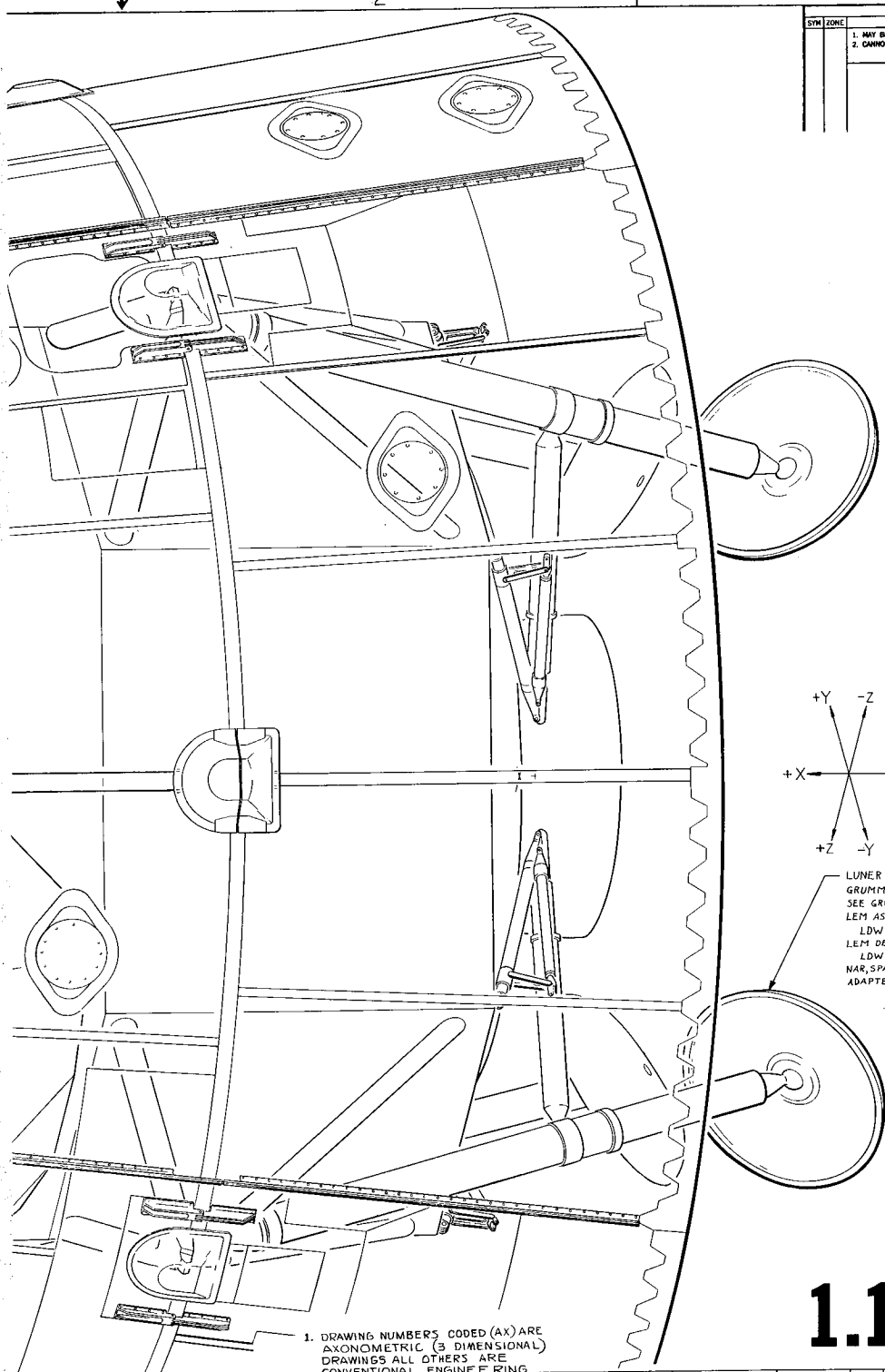
LAUNCH ESCAPE SYS., FIELD SITE INSTL.
F01-100078 (REF.)

GENERAL ASSEMBLY~LAUNCH ESCAPE SYS.
V35-000002 (REF.)


ELECTRICAL SYSTEMS INSTALLATION COMPLETE~ COMMAND MODULE V36-440001 (AX) (REF)
ELECTRICAL SYSTEMS INSTALLATION COMPLETE~SERVICE MODULE V37-400001 (REF.)
INSTRUMENTATION INSTL COMPLETE V34-750004 (REF)
GENERAL ASSEMBLY~ COMPLETE V37-000002 (REF.)
SYSTEMS INSTALLATION~ COMPLETE V37-200001 (REF)
SERVICE MODULE STRUCTURE ASSEMBLY COMPLETE V37-300001 (REF.)
PROPELLANT SYSTEM ASS'Y REACTION CONTROL SYSTEM QUADS "A" & "C" V37-400111 (AX) (REF)
POSITIVE PITCH ENGINE PANEL V16-312025 (REF)
PITCH ENGINE ACCESS V36-321479 (REF.)
AIR VENT V16-321404 (REF.)
ROLL ENGINE ACCESS V36-321480 II (REF.)
ROLL ENGINE PANEL V16-321125 (REF.)
(SIDE WINDOW V36-321500 REF.)
ROLL ENGINE ACCESS V36-321478 II (REF.)
YAW ENGINE ACCESS V36-321480 (REF.)
AFT COMP HEAT SHIELD COMPLETE V36-327020 (REF.)
FAIRING COMMAND TO SERVICE MODULE~ INSTALL. V37-310001 (REF.)
QUAD "C"
QUAD "B"
(MODULAR ASS'Y REACTION CONTROL SYS. COMPLETE V37-400110 (AX) REF)
S/M REACTION CONTROL SYS., ENGINE ASSY, TYP 4 PLACES, V17-430011 (AX) (REF)
REACTION CONTROL SYS. ELECTRICAL WIRING AND EQUIP INSTALLATION ENGINE V37-445002 (AX) (REF)
PROPELLANT SYSTEM ASSY., REACTION CONTROL SYSTEM, QUADS "B" & "D" V37-400112 (AX) (REF)
MODULE INSTALLATION~ COMPLETE V37-400109 (AX) (REF)
ELECTRICAL POWER SYSTEM RADIATOR V37-458010 (AX) (REF)
URINE DUMP NOZZLE V36-610500 (AX) (REF)
NEGATIVE YAW ENGINES V16-312025 (REF.)
STEAM VENT V36-610500 (AX) (REF)
REACTION CONTROL SYS. FUEL DISPOSAL V36-400101 (AX) (REF)
STACK GENERAL ASS'Y V34-000002 (REF.)
ENVIRONM RADIATOR


5
4
3
FIELD SITE INSTALLATION, ORDNANCE~COMPLETE F01-100406 (AX)(REF)
CONTROL SYS. 222201 (REF.)
SERVICE PROPULSION SYSTEM NOZZLE EXTENSION (REF.)
SERVICE PROPULSION SYSTEM COMPLETE V37-400201 (AX)(REF)
ADAPTER ASSY.~ COMPLETE STRUCTURE V24-328003 (REF.)
5
4
3

REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED
		1. MAY BE REWORKED 3. RECORD CHANGE 2. CANNOT BE REWORKED 4. NOW SHOP PRACTICE 5. PARTS MADE OK	DIVISION	



LUNER EXCURSION MODULE, MANUFACTURED BY
GRUMMAN AIRCRAFT ENGINEERING CORP
SEE GRUMMAN DRAWINGS
LEM ASCENT STAGE, EXTERNAL PROFILE ~
LDW 28-10012
LEM DESCENT STAGE, EXTERNAL PROFILE ~
LDW 280-17000
NAR, SPACE SYSTEMS DIVISION DRAWING
ADAPTER/LEM CLEARANCE GAEC-NAA~MH01-05066-124

1.1 STR

1. DRAWING NUMBERS CODED (AX) ARE AXONOMETRIC (3 DIMENSIONAL) DRAWINGS ALL OTHERS ARE CONVENTIONAL ENGINEERING DRAWINGS.

NOTES: UNLESS OTHERWISE SPECIFIED

ZONES		
1-12	SH	1
13-24	SH	2
25-36	SH	3
37-48	SH	4
49-60	SH	5
61-72	SH	6
73-84	SH	7
85-96	SH	8
97-108	SH	9

LAST SECTION LETTER USED: T-T

ITEM	QTY	MODEL	NEXT USING DRAWING	END ITEM NO.	THRU
REQD PER END ITEM		V343		104	ONLY
				EFFECTIVE ON	

APPLICATION (USAGE) DATA

QTY REQD	QTY REQD	QTY REQD	QTY REQD	QTY REQD	QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT	MATERIAL	DATA: SPECIFICATION SIZES, NOTES, SUPPLIERS	ZONE	LINE NO.
						V34-000104	APOLLO COMPLETE					001

LIST OF MATERIAL OR PARTS LIST

HEAT TREAT

FINISH

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. TOLERANCES ON: DECIMALS ANGLES XX ± .03 ±30' XXX ± .010
HOLES NOTED "DRILL"
.013 THRU .040 : +.001 -.001
.041 THRU .130 : +.002 -.001
.131 THRU .229 : +.003 -.001
.230 THRU .500 : +.004 -.001
.501 THRU .750 : +.005 -.001
.751 THRU 1.000 : +.007 -.001
1.001 THRU 2.000 : +.010 -.001

DO NOT SCALE PRINT

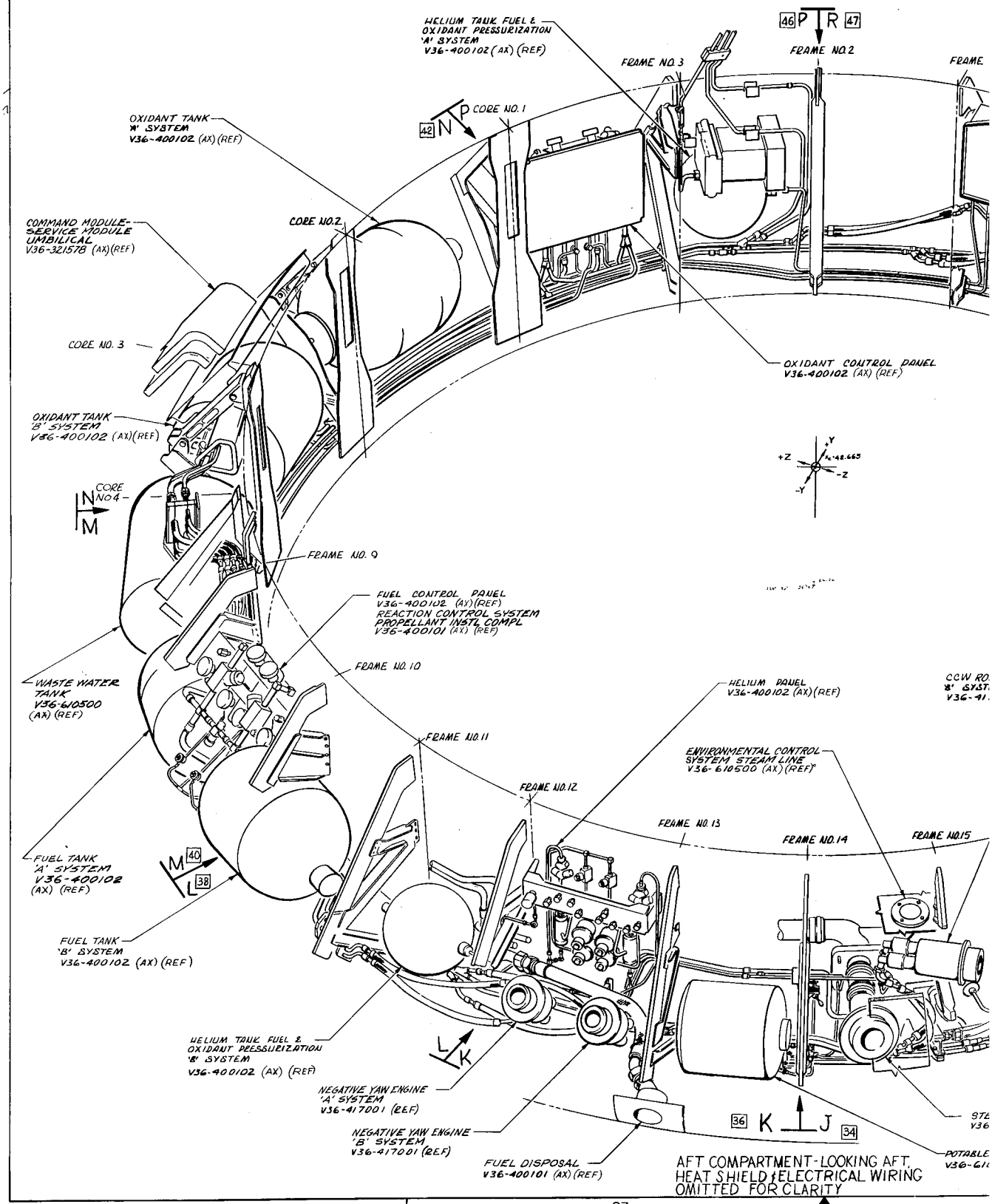
DR BY L. BOYER
CHK BY R. ROSS
APPROVED BY

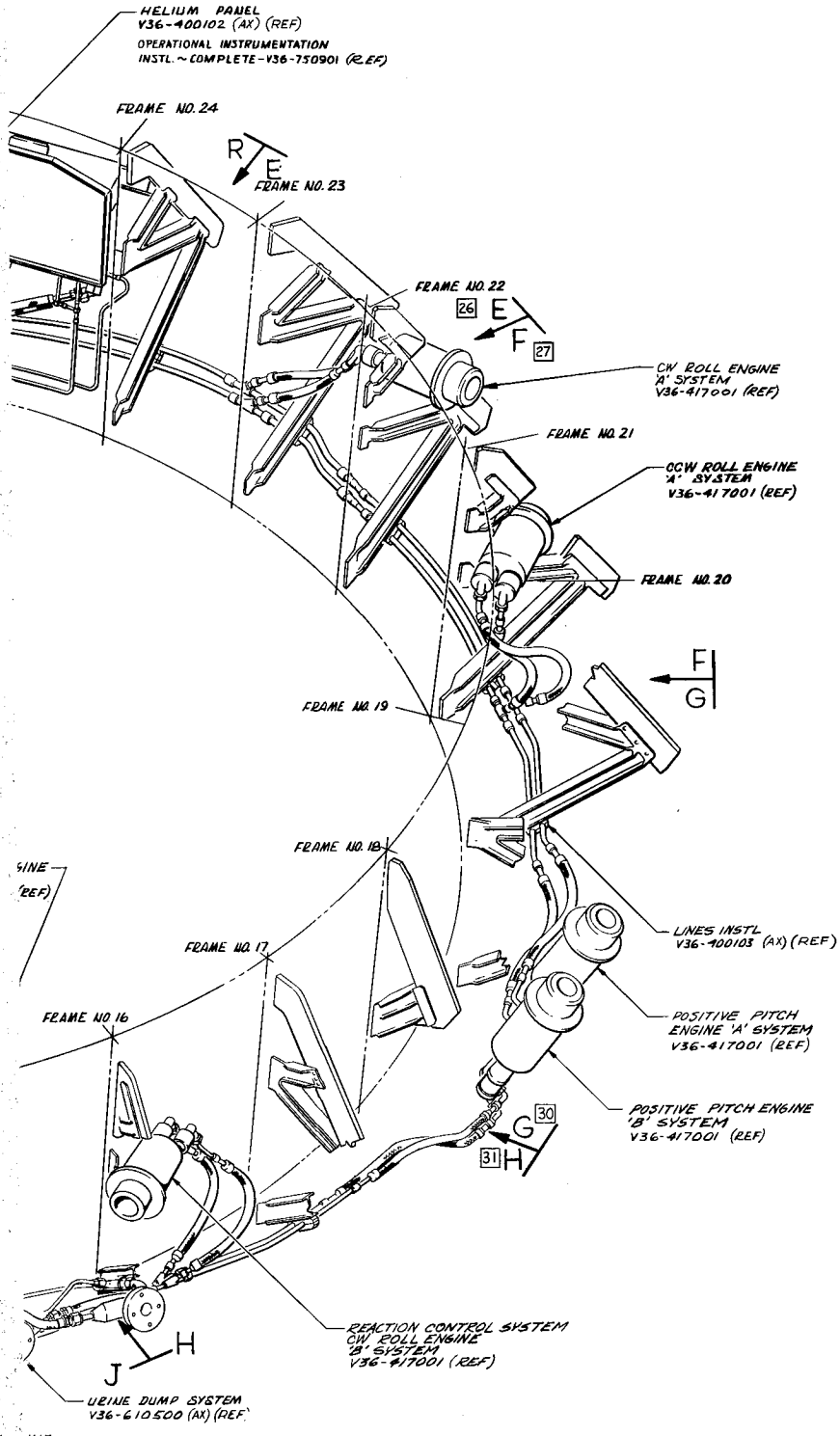
NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION
12214 LAKEWOOD BLVD. DOWNEY, CALIFORNIA

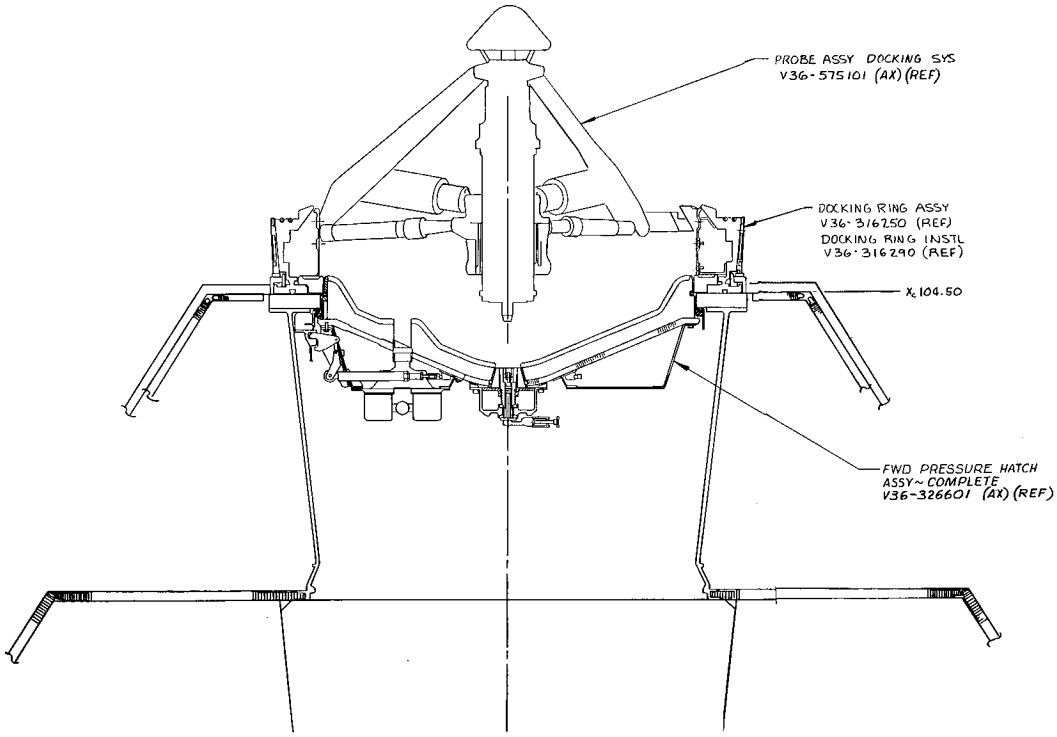
INBOARD PROFILE - APOLLO, COMPLETE

CODE IDENT NO 03953 | SIZE J

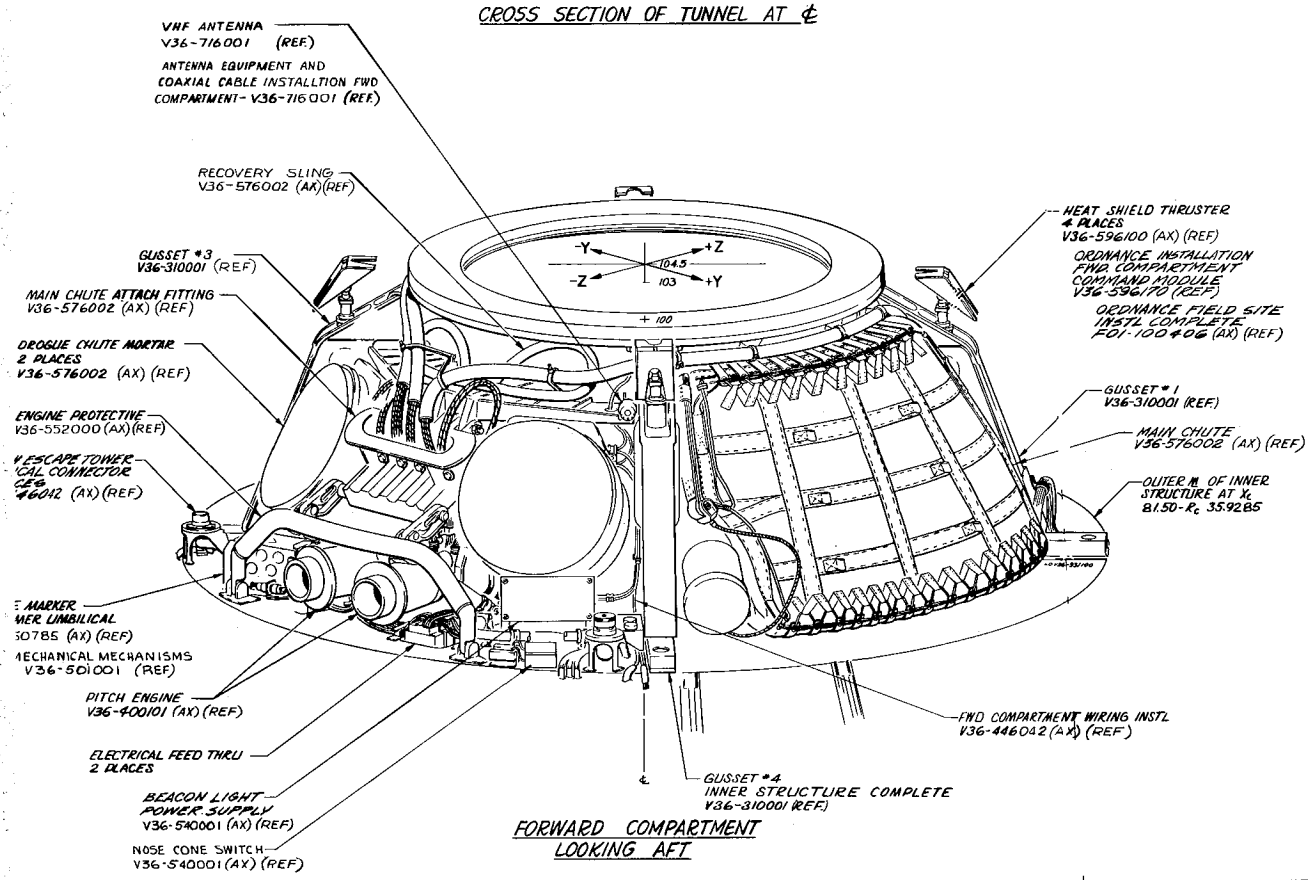
SCALE NONE | SHEET 1 OF 9


24
23
HELIUM TANK FUEL & OXIDANT PRESSURIZATION 'A' SYSTEM V36-400102 (AX) (REF)
46 P T R 47
FRAME NO. 3
FRAME NO. 2
FRAME
42 M P CORE NO. 1
OXIDANT TANK 'A' SYSTEM V36-400102 (AX) (REF)
COMMAND MODULE-SERVICE MODULE UMBILICAL V36-321578 (AX) (REF)
CORE NO. 2
CORE NO. 3
OXIDANT CONTROL PANEL V36-400102 (AX) (REF)
OXIDANT TANK 'B' SYSTEM V36-400102 (AX) (REF)
+Z
Y
X 48.665
-Z
-Y
N M CORE NO. 4
FRAME NO. 9
FUEL CONTROL PANEL V36-400102 (AX) (REF)
REACTION CONTROL SYSTEM PROPELLANT INSTL COMPL V36-400101 (AX) (REF)
FRAME NO. 10
WASTE WATER TANK V36-610500 (AX) (REF)
HELIUM PANEL V36-400102 (AX) (REF)
FRAME NO. 11
ENVIRONMENTAL CONTROL SYSTEM STEAM LINE V36-610500 (AX) (REF)
FRAME NO. 12
FRAME NO. 13
FRAME NO. 14
FRAME NO. 15
M 40 L 38
FUEL TANK 'A' SYSTEM V36-400102 (AX) (REF)
FUEL TANK 'B' SYSTEM V36-400102 (AX) (REF)
HELIUM TANK FUEL & OXIDANT PRESSURIZATION 'B' SYSTEM V36-400102 (AX) (REF)
L K
NEGATIVE YAW ENGINE 'A' SYSTEM V36-417001 (REF)
NEGATIVE YAW ENGINE 'B' SYSTEM V36-417001 (REF)
36 K J 34
FUEL DISPOSAL V36-400101 (AX) (REF)
AFT COMPARTMENT-LOOKING AFT. HEAT SHIELD & ELECTRICAL WIRING OMITTED FOR CLARITY
24
23

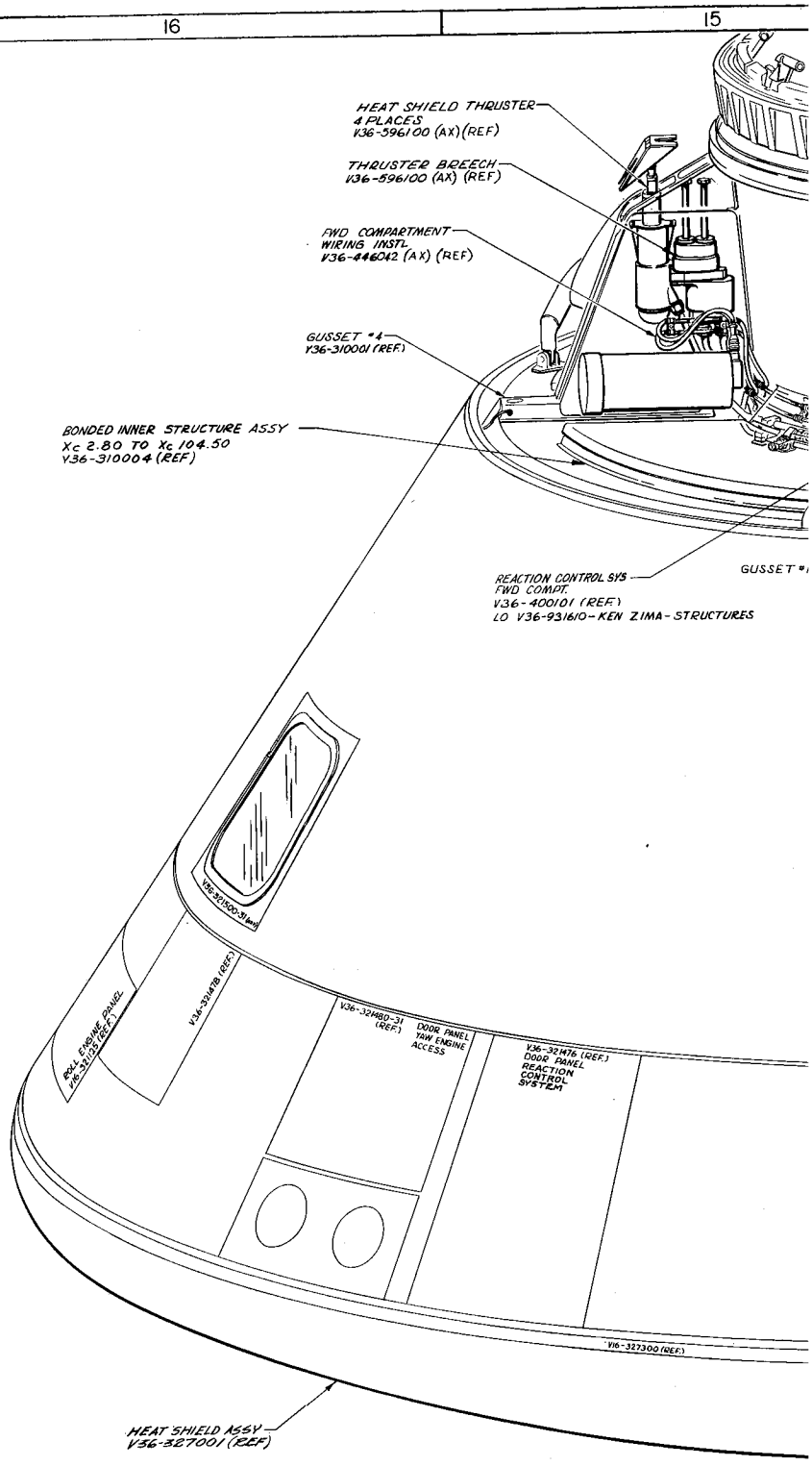

HELIUM PANEL
V36-400102 (AX) (REF)
OPERATIONAL INSTRUMENTATION
INSTL. ~ COMPLETE - V36-750901 (REF)
FRAME NO. 24
R
E
FRAME NO. 23
FRAME NO. 22
26
E
F
27
CW ROLL ENGINE
'A' SYSTEM
V36-417001 (REF)
FRAME NO. 21
CCW ROLL ENGINE
'A' SYSTEM
V36-417001 (REF)
FRAME NO. 20
F
G
FRAME NO. 19
FRAME NO. 18
LINES INSTL
V36-400103 (AX) (REF)
FRAME NO. 17
POSITIVE PITCH
ENGINE 'A' SYSTEM
V36-417001 (REF)
FRAME NO. 16
POSITIVE PITCH ENGINE
'B' SYSTEM
V36-417001 (REF)
30
G
31
H
C
H
J
REACTION CONTROL SYSTEM
CW ROLL ENGINE
'B' SYSTEM
V36-417001 (REF)
URINE DUMP SYSTEM
V36-610500 (AX) (REF)

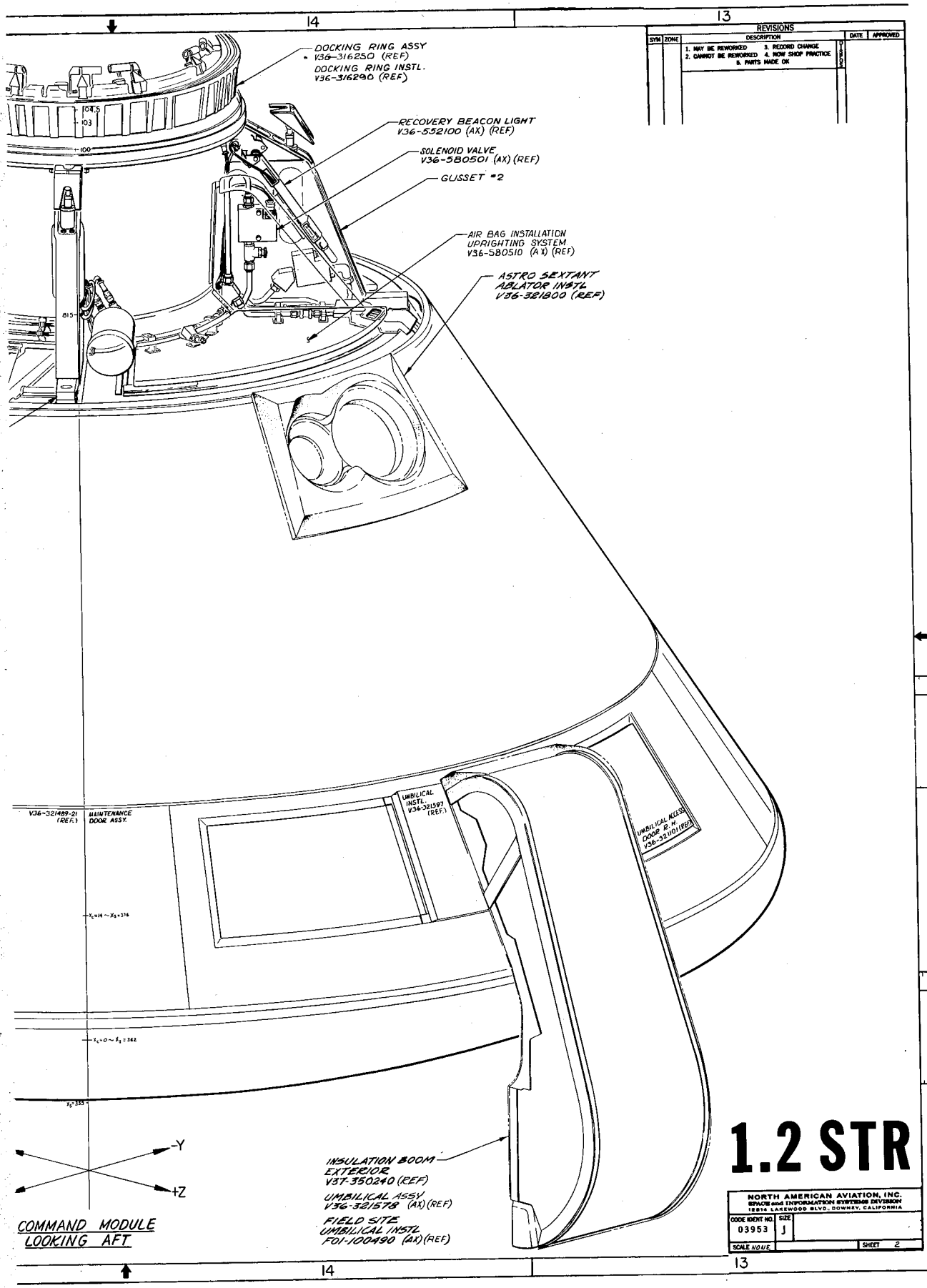


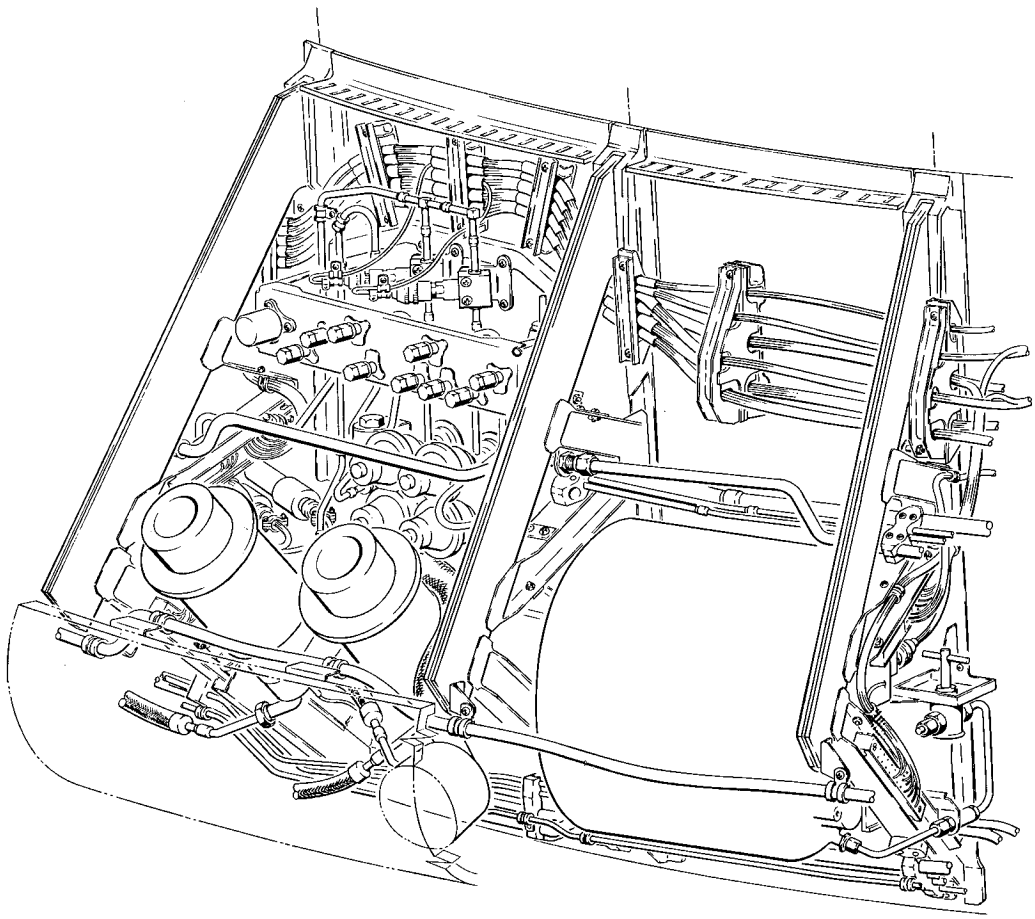
CROSS SECTION OF TUNNEL AT ℄

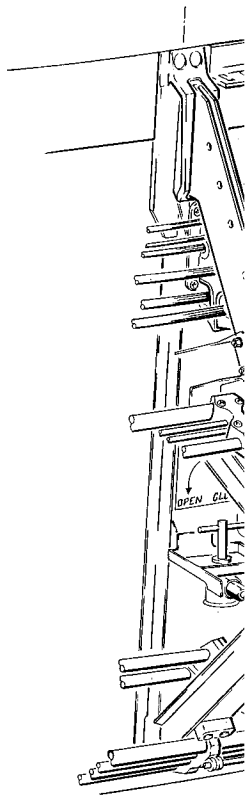


FORWARD COMPARTMENT
LOOKING AFT


HEAT SHIELD THRUSTER
4 PLACES
V36-596100 (AX)(REF)
THRUSTER BREECH
V36-596100 (AX) (REF)
FWD COMPARTMENT
WIRING INSTL
V36-446042 (AX) (REF)
GUSSET #4
V36-310001 (REF)
BONDED INNER STRUCTURE ASSY
Xc 2.80 TO Xc 104.50
V36-310004 (REF)
REACTION CONTROL SYS
FWD COMPT.
V36-400101 (REF)
LO V36-931610-KEN ZIMA-STRUCTURES
GUSSET #
V36-321300-31 (REF)
V36-321478 (REF)
V36-321480-31 (REF)
DOOR PANEL
YAW ENGINE
ACCESS
V36-321476 (REF.)
DOOR PANEL
REACTION
CONTROL
SYSTEM
V16-327300 (REF.)
HEAT SHIELD ASSY
V36-327001 (REF)


14
13
REVISIONS
SYM | ZONE | DESCRIPTION | DATE | APPROVED
1. MAY BE REWORKED 3. RECORD CHANGE
2. CANNOT BE REWORKED 4. NOW SHOP PRACTICE
5. PARTS MADE OK
DOCKING RING ASSY
V36-316250 (REF)
DOCKING RING INSTL.
V36-316290 (REF)
RECOVERY BEACON LIGHT
V36-552100 (AX) (REF)
SOLENOID VALVE
V36-580501 (AX) (REF)
GUSSET #2
AIR BAG INSTALLATION
UPRIGHTING SYSTEM
V36-580510 (AX) (REF)
ASTRO SEXTANT
ABLATOR INSTL
V36-321800 (REF)
104.5
103
100
81.5
V36-321489-21 (REF.)
MAINTENANCE DOOR ASSY.
UMBILICAL INSTL V36-321597 (REF.)
UMBILICAL ACCESS DOOR R.H. V36-321101 (REF.)
-Y
+Z
INSULATION BOOM EXTERIOR
V37-350240 (REF)
UMBILICAL ASSY
V36-321578 (AX) (REF)
FIELD SITE
UMBILICAL INSTL
F01-1000490 (AX) (REF)
COMMAND MODULE
LOOKING AFT
1.2 STR
NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION
12214 LAKEWOOD BLVD., DOWNEY, CALIFORNIA
CODE IDENT NO. 03953
SIZE J
SCALE NONE
SHEET 2
14
13

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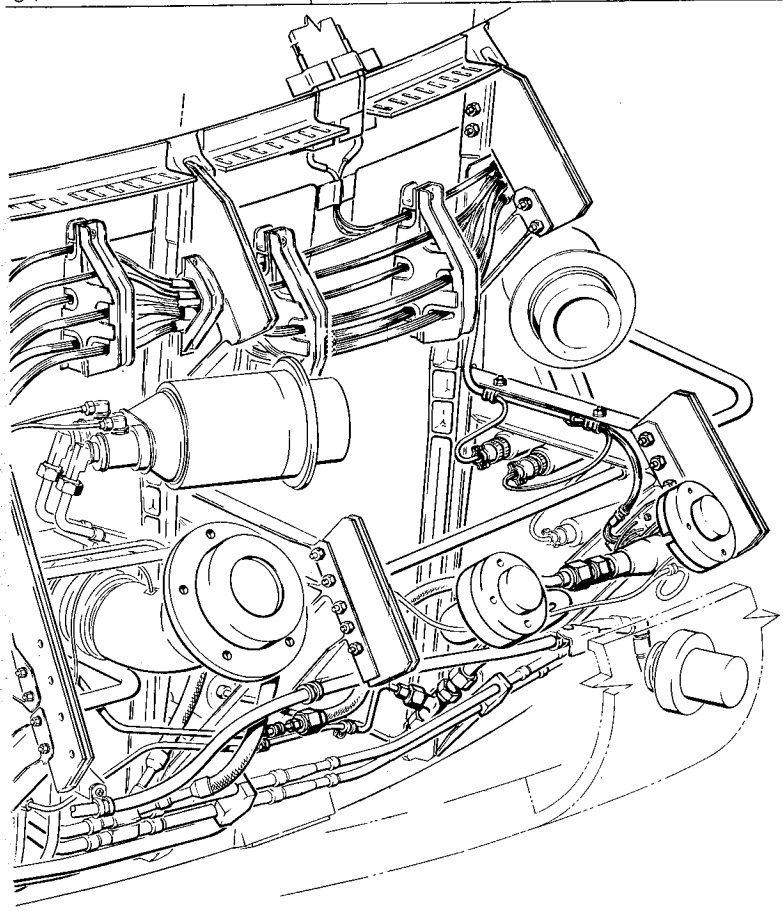
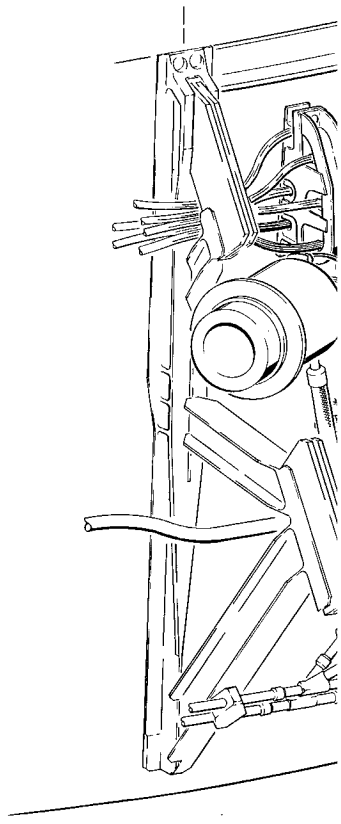
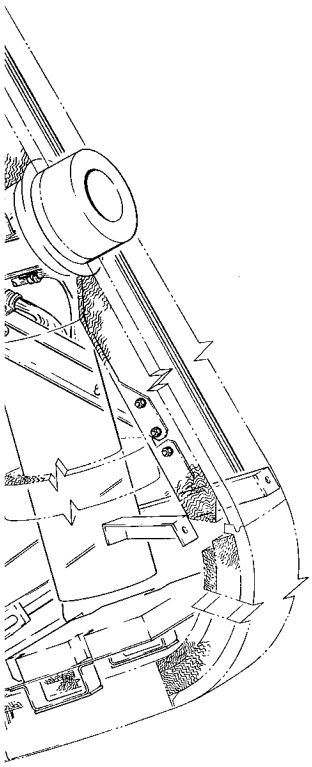
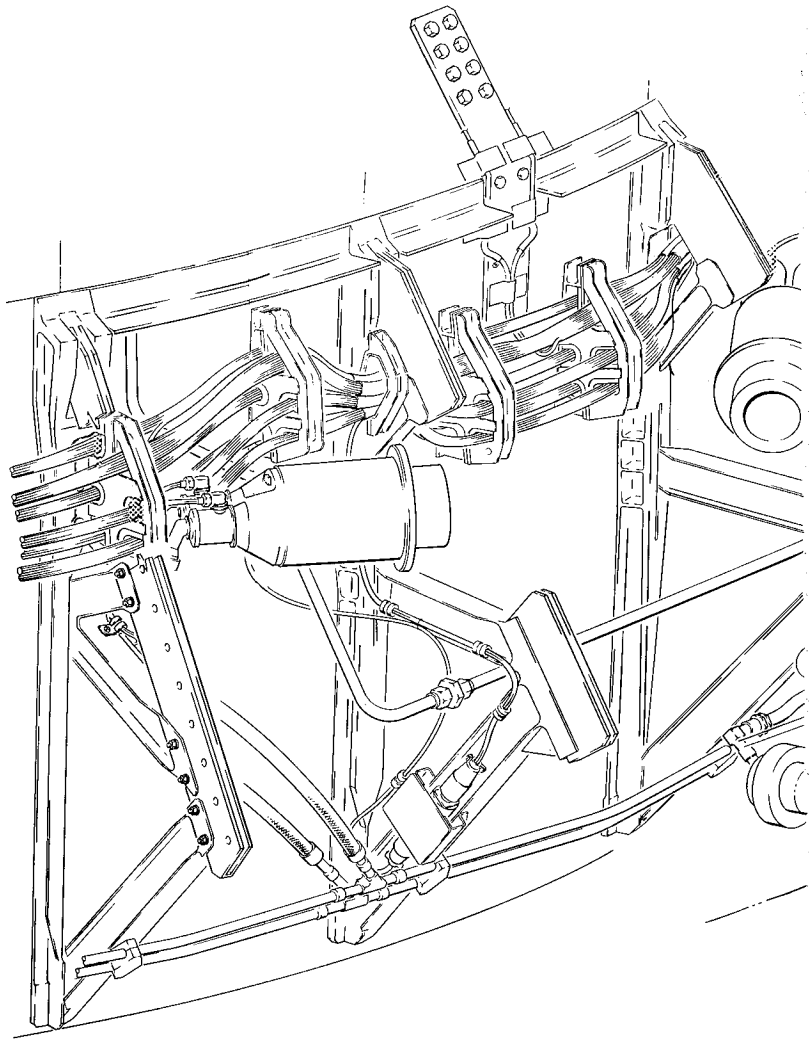
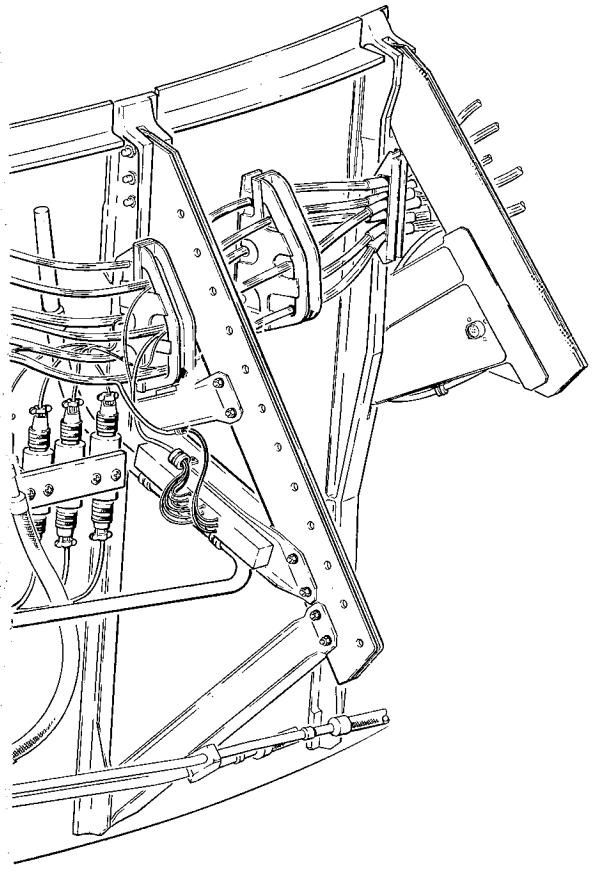
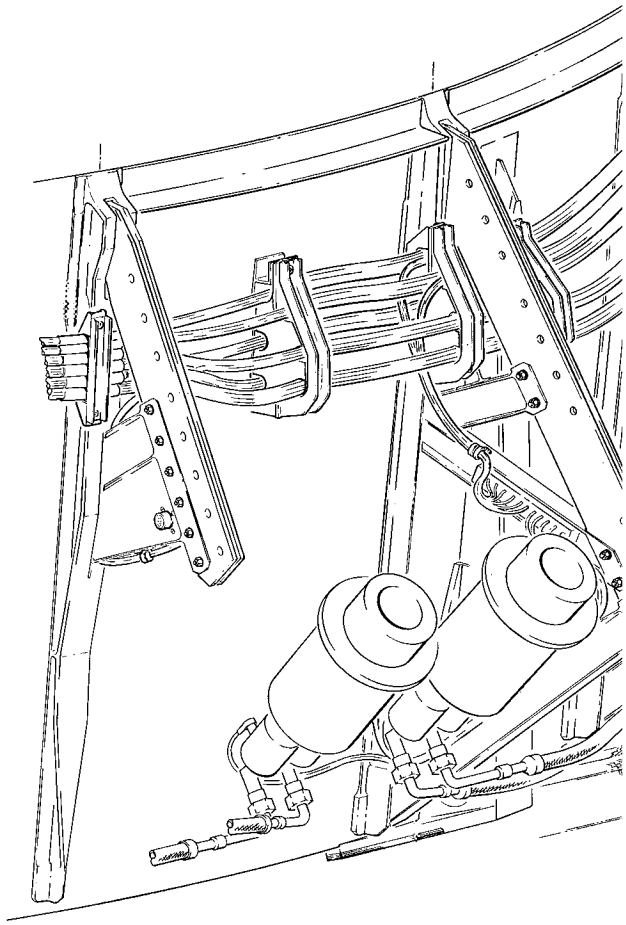






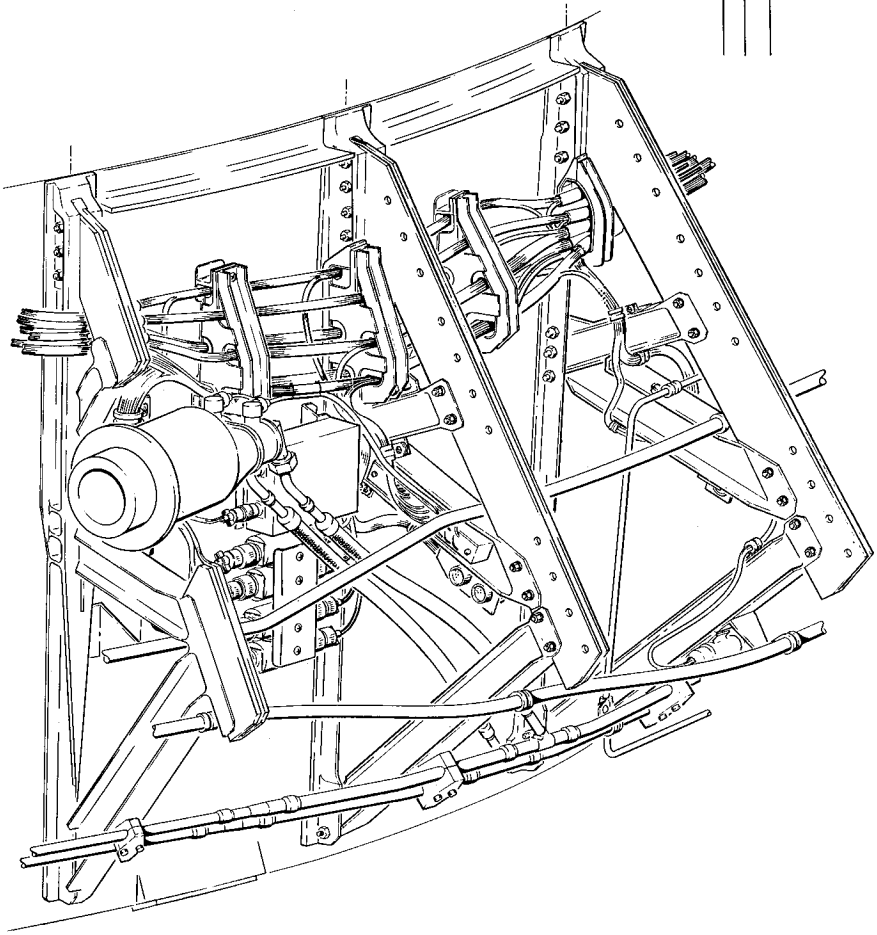






26 25

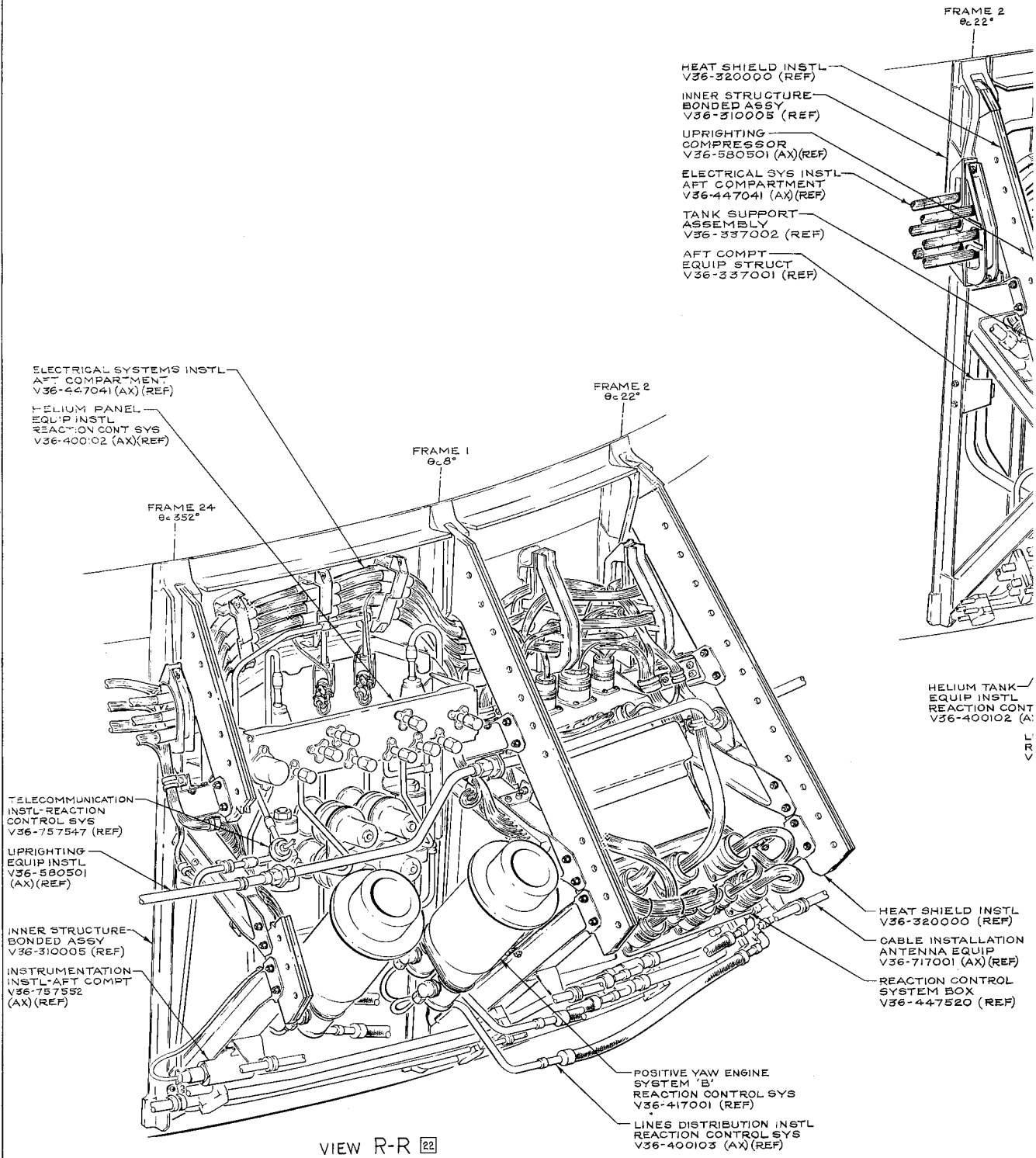
REVISIONS			
SYM	ZONE	DESCRIPTION	DATE	APPROVED
		1. MAY BE REWORKED 3. RECORD CHANGE 2. CANNOT BE REWORKED 4. NOW SHOP PRACTICE 5. PARTS MADE OK	0180S	



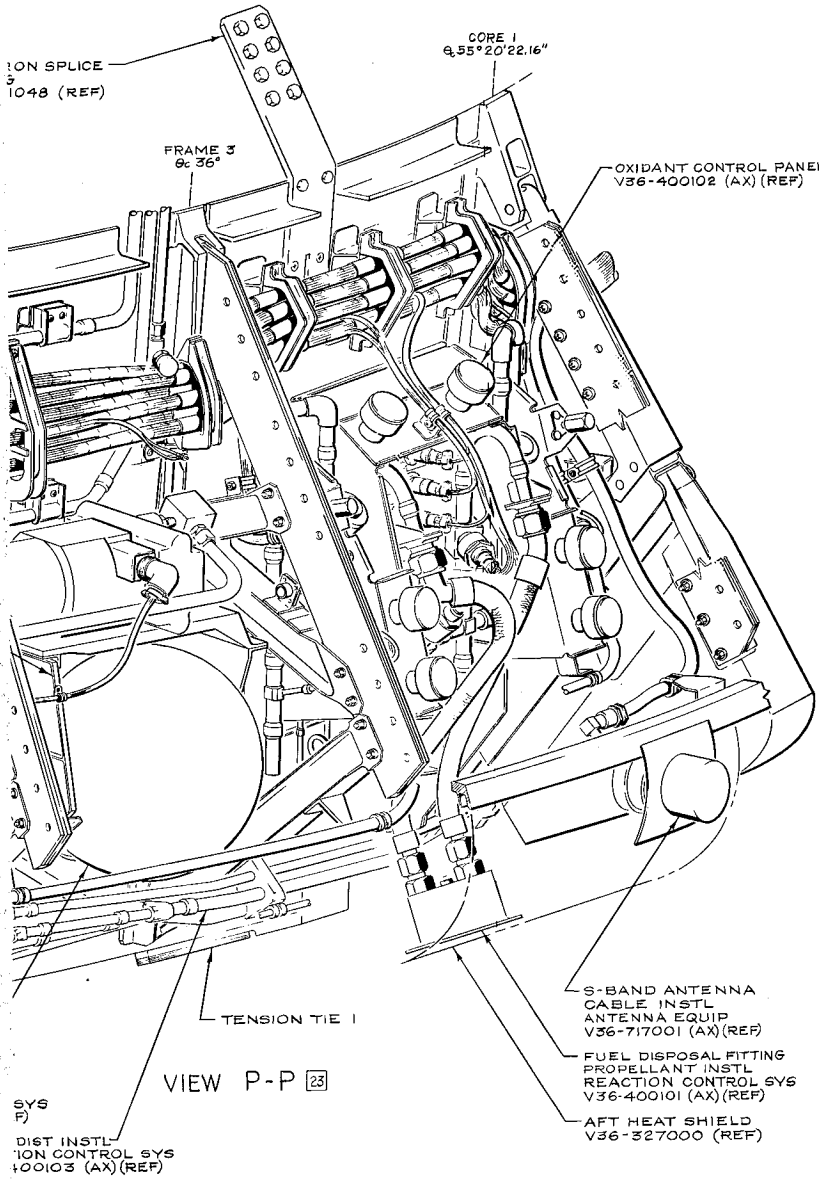
1.3 STR

NORTH AMERICAN AVIATION, INC. SPACE and INFORMATION SYSTEMS DIVISION 12214 LAKEWOOD BLVD., DOWNEY, CALIFORNIA		
CODE IDENT NO 03953	SIZE J	
SCALE NONE		SHEET

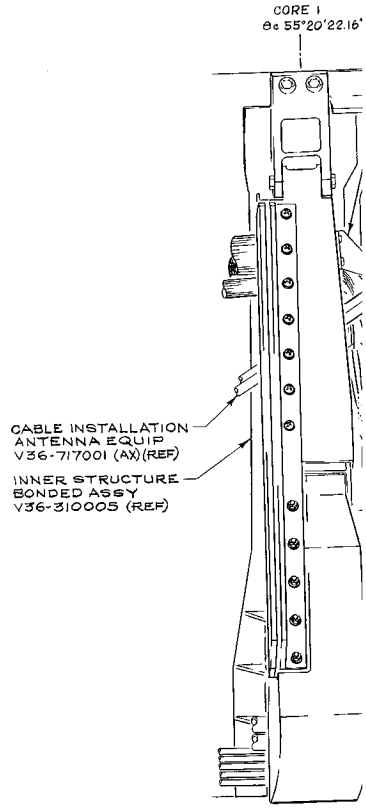
26 25

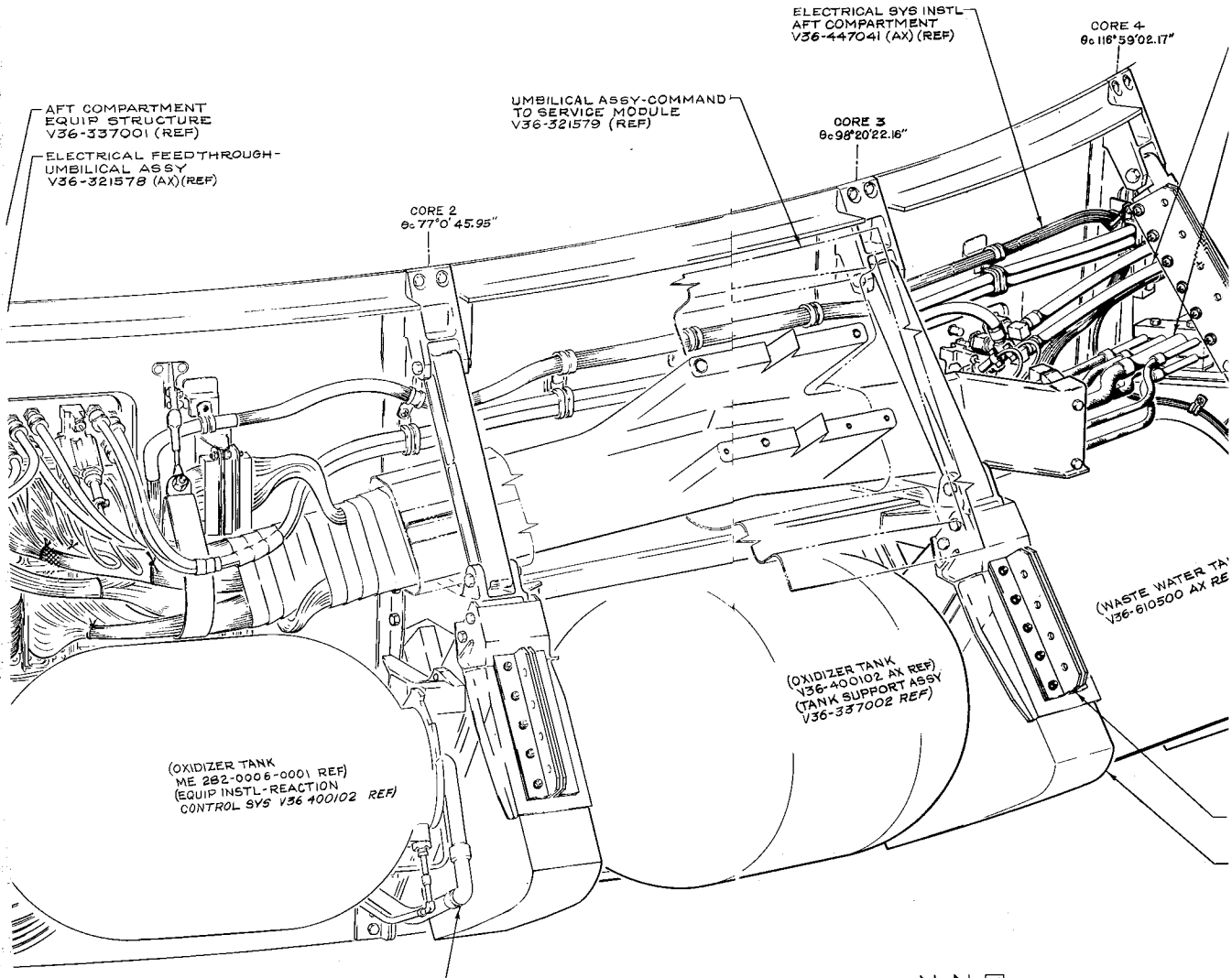

FRAME 2
θc 22°
HEAT SHIELD INSTL
V36-320000 (REF)
INNER STRUCTURE
BONDED ASSY
V36-310005 (REF)
UPRIGHTING
COMPRESSOR
V36-580501 (AX)(REF)
ELECTRICAL SYS INSTL
AFT COMPARTMENT
V36-447041 (AX)(REF)
TANK SUPPORT
ASSEMBLY
V36-337002 (REF)
AFT COMPT
EQUIP STRUCT
V36-337001 (REF)
HELIUM TANK
EQUIP INSTL
REACTION CONT
V36-400102 (A
ELECTRICAL SYSTEMS INSTL
AFT COMPARTMENT
V36-447041 (AX) (REF)
HELIUM PANEL
EQUIP INSTL
REACTION CONT SYS
V36-400102 (AX)(REF)
FRAME 2
θc 22°
FRAME 1
θc 8°
FRAME 24
θc 352°
TELECOMMUNICATION
INSTL-REACTION
CONTROL SYS
V36-757547 (REF)
UPRIGHTING
EQUIP INSTL
V36-580501
(AX)(REF)
INNER STRUCTURE
BONDED ASSY
V36-310005 (REF)
INSTRUMENTATION
INSTL-AFT COMPT
V36-757552
(AX)(REF)
HEAT SHIELD INSTL
V36-320000 (REF)
CABLE INSTALLATION
ANTENNA EQUIP
V36-717001 (AX)(REF)
REACTION CONTROL
SYSTEM BOX
V36-447520 (REF)
POSITIVE YAW ENGINE
SYSTEM 'B'
REACTION CONTROL SYS
V36-417001 (REF)
LINES DISTRIBUTION INSTL
REACTION CONTROL SYS
V36-400103 (AX)(REF)

VIEW R-R 22


ION SPLICE
1048 (REF)
CORE 1
@ 55°20'22.16"
FRAME 3
@ 36°
OXIDANT CONTROL PANEL
V36-400102 (AX) (REF)
TENSION TIE 1
S-BAND ANTENNA
CABLE INSTL
ANTENNA EQUIP
V36-717001 (AX) (REF)
FUEL DISPOSAL FITTING
PROPELLANT INSTL
REACTION CONTROL SYS
V36-400101 (AX) (REF)
AFT HEAT SHIELD
V36-327000 (REF)
SYS
F)
DIST INSTL
ION CONTROL SYS
400103 (AX) (REF)

VIEW P-P 23


CORE 1
@ 55°20'22.16"
CABLE INSTALLATION
ANTENNA EQUIP
V36-717001 (AX) (REF)
INNER STRUCTURE
BONDED ASSY
V36-310005 (REF)


AFT COMPARTMENT
EQUIP STRUCTURE
V36-337001 (REF)
ELECTRICAL FEEDTHROUGH-
UMBILICAL ASSY
V36-321578 (AX)(REF)
UMBILICAL ASSY-COMMAND
TO SERVICE MODULE
V36-321579 (REF)
ELECTRICAL SYS INSTL
AFT COMPARTMENT
V36-447041 (AX) (REF)
CORE 4
θc 116°59'02.17"
CORE 3
θc 98°20'22.16"
CORE 2
θc 77°0'45.95"
(OXIDIZER TANK
ME 282-0006-0001 REF)
(EQUIP INSTL-REACTION
CONTROL SYS V36 400102 REF)
(OXIDIZER TANK
V36-400102 AX REF)
(TANK SUPPORT ASSY
V36-337002 REF)
(WASTE WATER TA
V36-610500 AX RE
LINES DISTRIBUTION INSTL
REACTION CONTROL SYS
V36-400103 (AX)(REF)
PROPELLANT INSTL
REACTION CONTROL SYS
V36-400101 (AX)(REF)

VIEW N-N 24

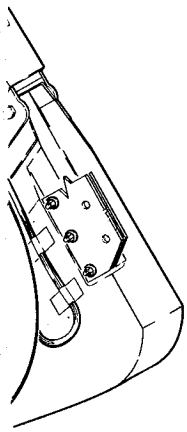
,BLE INSTALLATION
NTENNA EQUIP
'6-717001 (AX)(REF)

NES, DUCT & WATER
NK INSTL- AFT COMPT
58-610500 (AX) (REF)

INNER ST
BONDED
V36-310

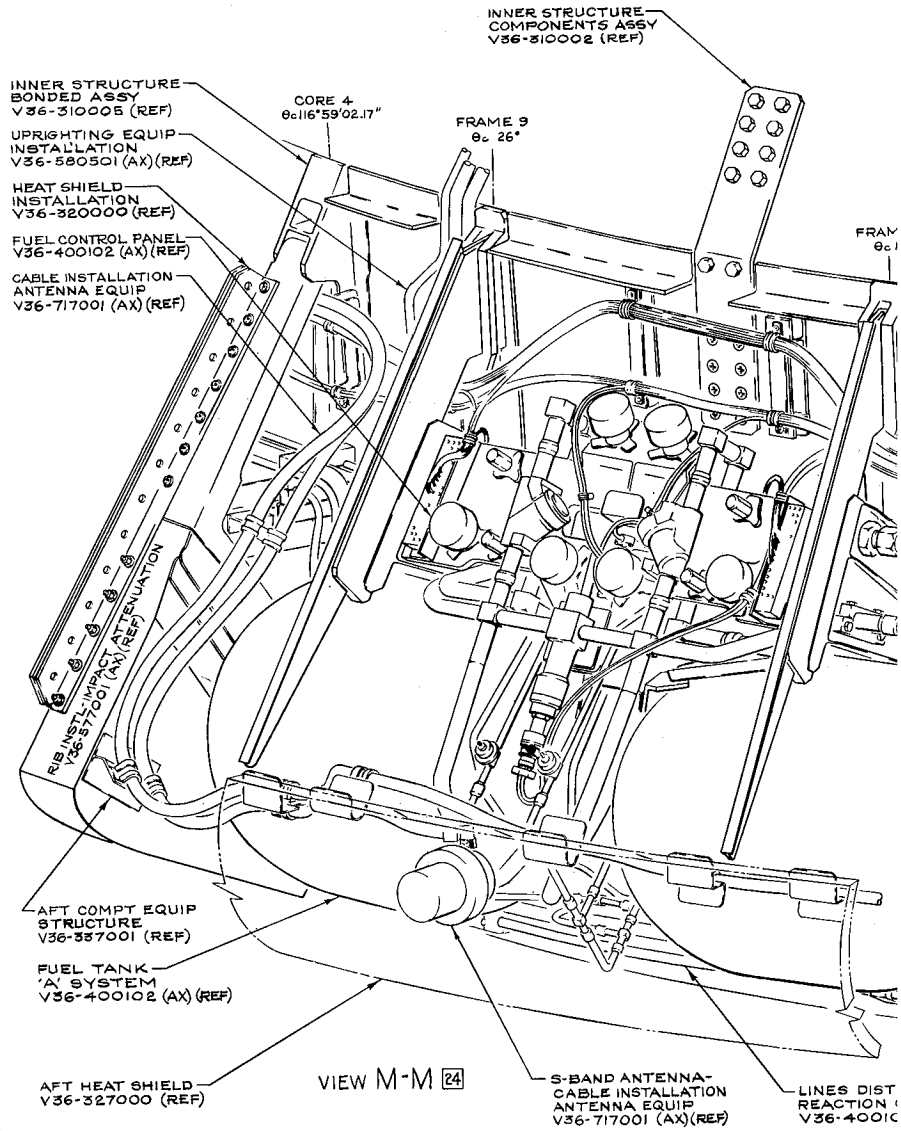
ELECTRI
INSTL, A
V36-447

UPRIGHT
INSTALL
V36-580



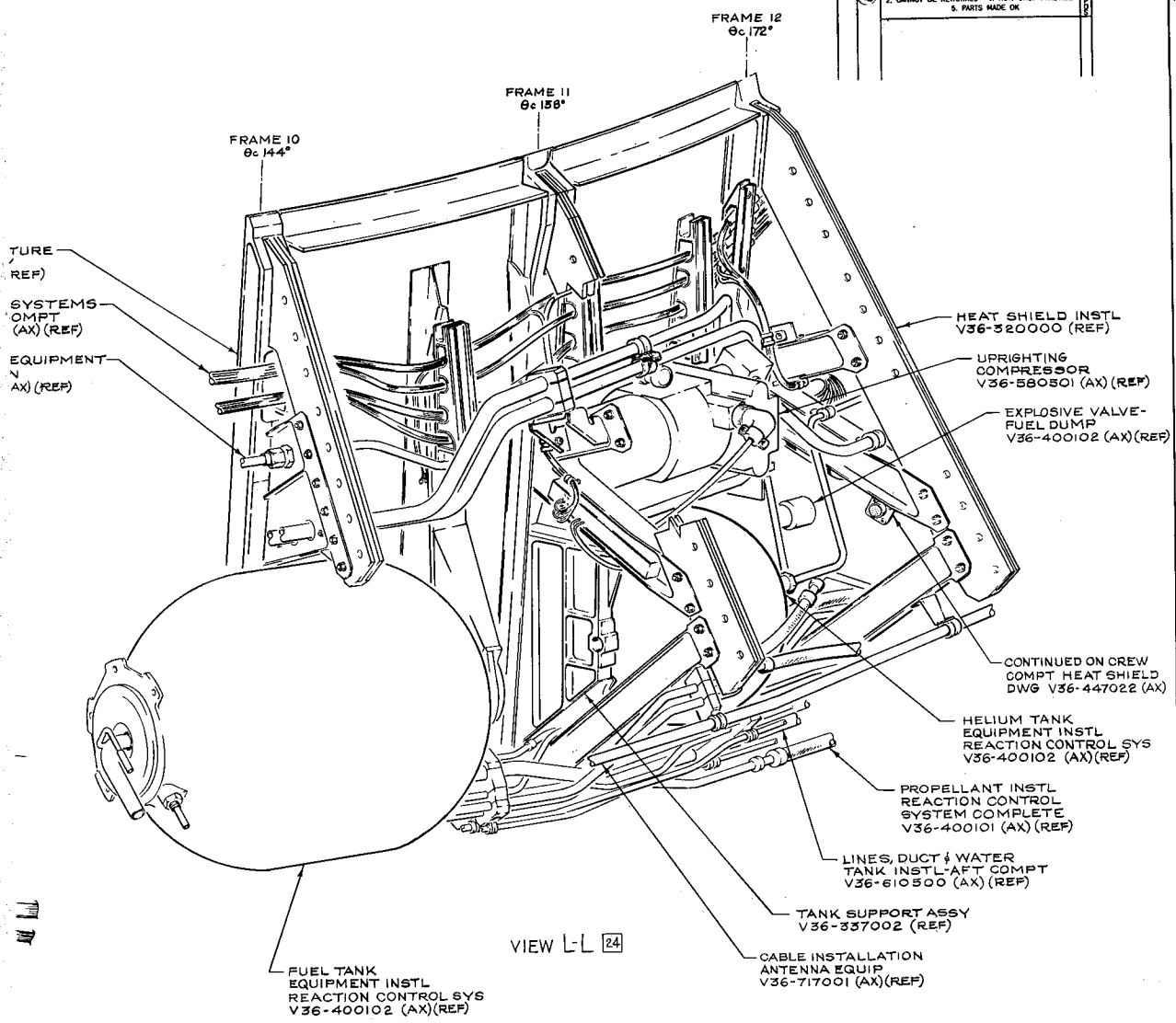
T SHIELD
'ALLATION
320000 (REF)

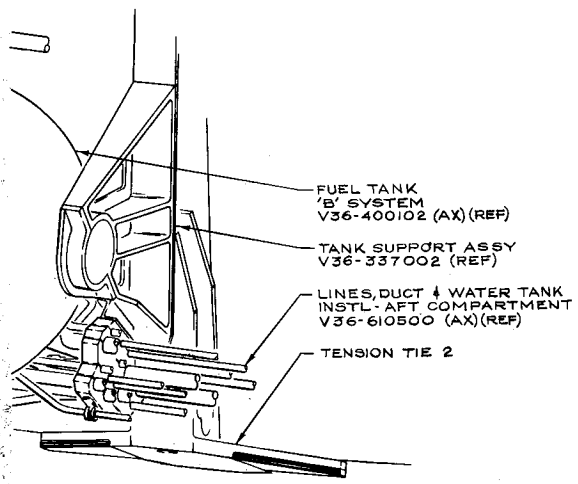
NSTALLATION
CT ATTENUATION
577001 (AX) (REF)



4

REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED
		1. MAY BE REWORKED 3. RECORD CHANGE 2. CANNOT BE REWORKED 4. NOW SHOP PRACTICE 5. PARTS MADE OK		

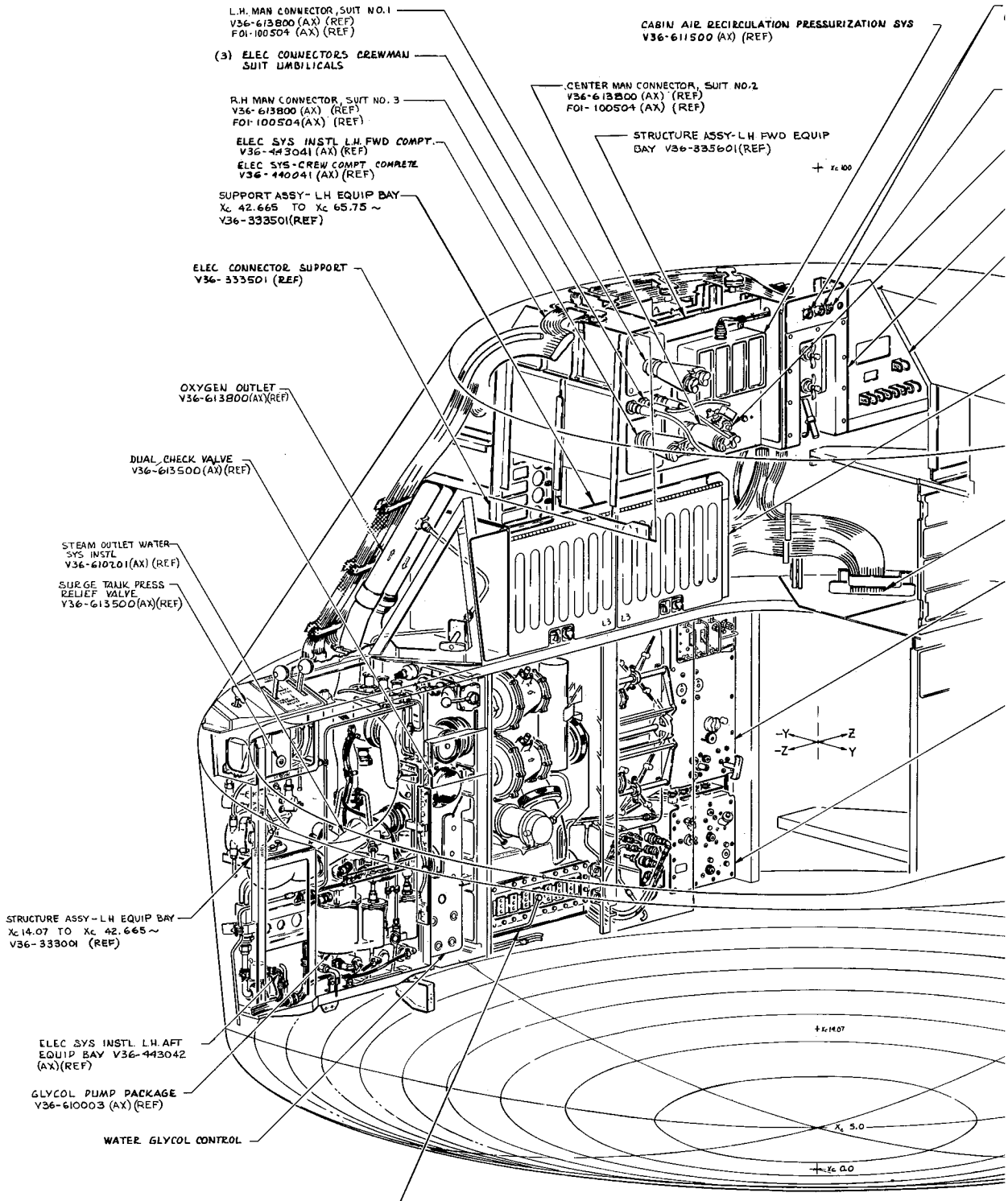




OL SYS
(REF)

1.4 STR

NORTH AMERICAN AVIATION, INC. SPACE and INFORMATION SYSTEMS DIVISION 12214 LAKEWOOD BLVD., DOWNEY, CALIFORNIA		
CODE IDENT NO. 03953	SIZE J	
SCALE NONE		SHEET 4



CREW COMPARTMENT~
LEFT HAND EQUIPMENT BAY
CLOSE-OUT PANELS OMITTED FOR CLARITY
CENTRAL CREW COMPARTMENT

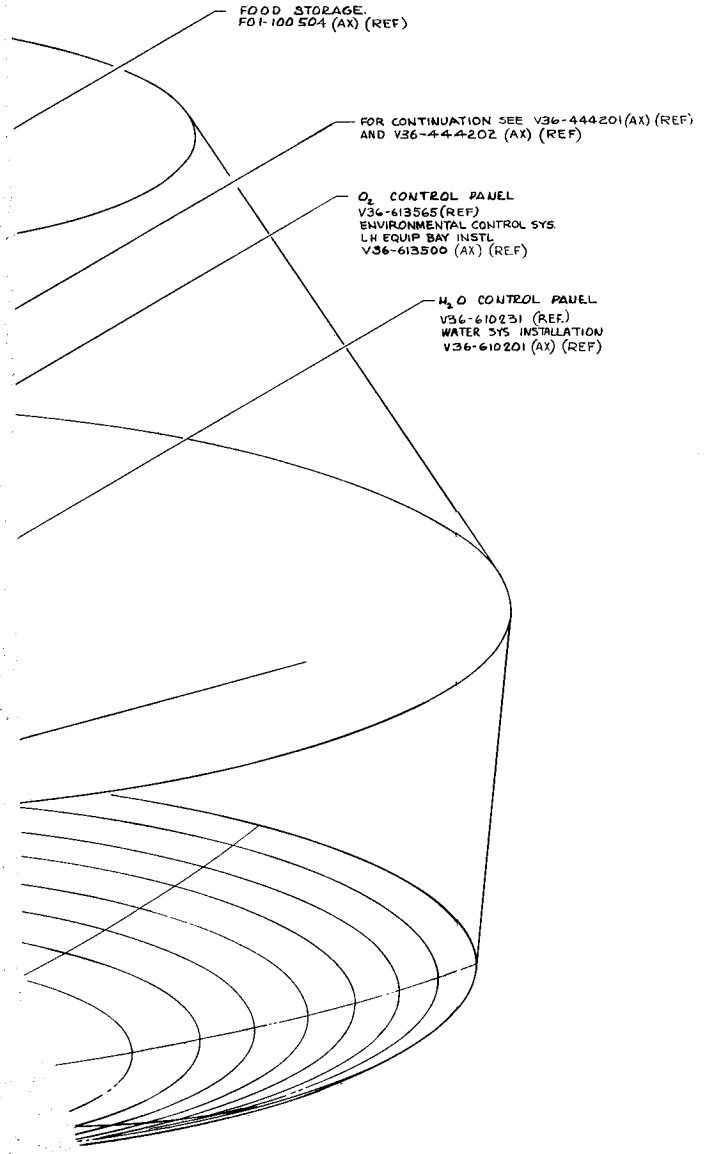
CONNECTOR
ATTEN LOCKOUT
443041 (AX) (REF)

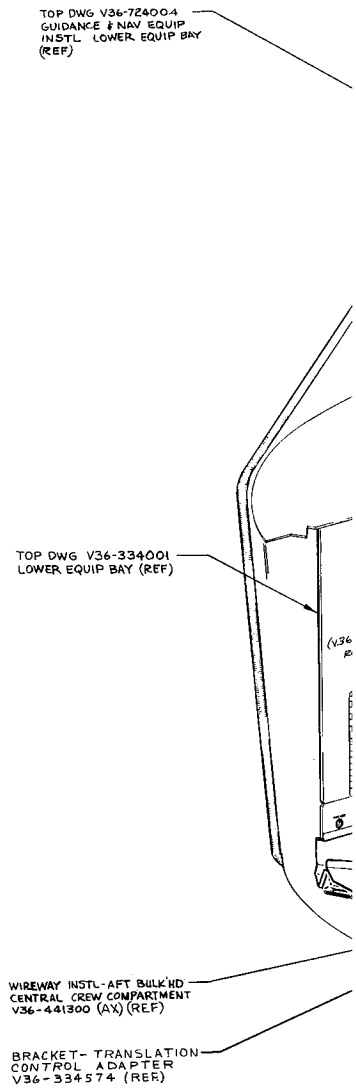
CONNECTOR RADIATION SURVEY METER
443041 (AX) (REF)

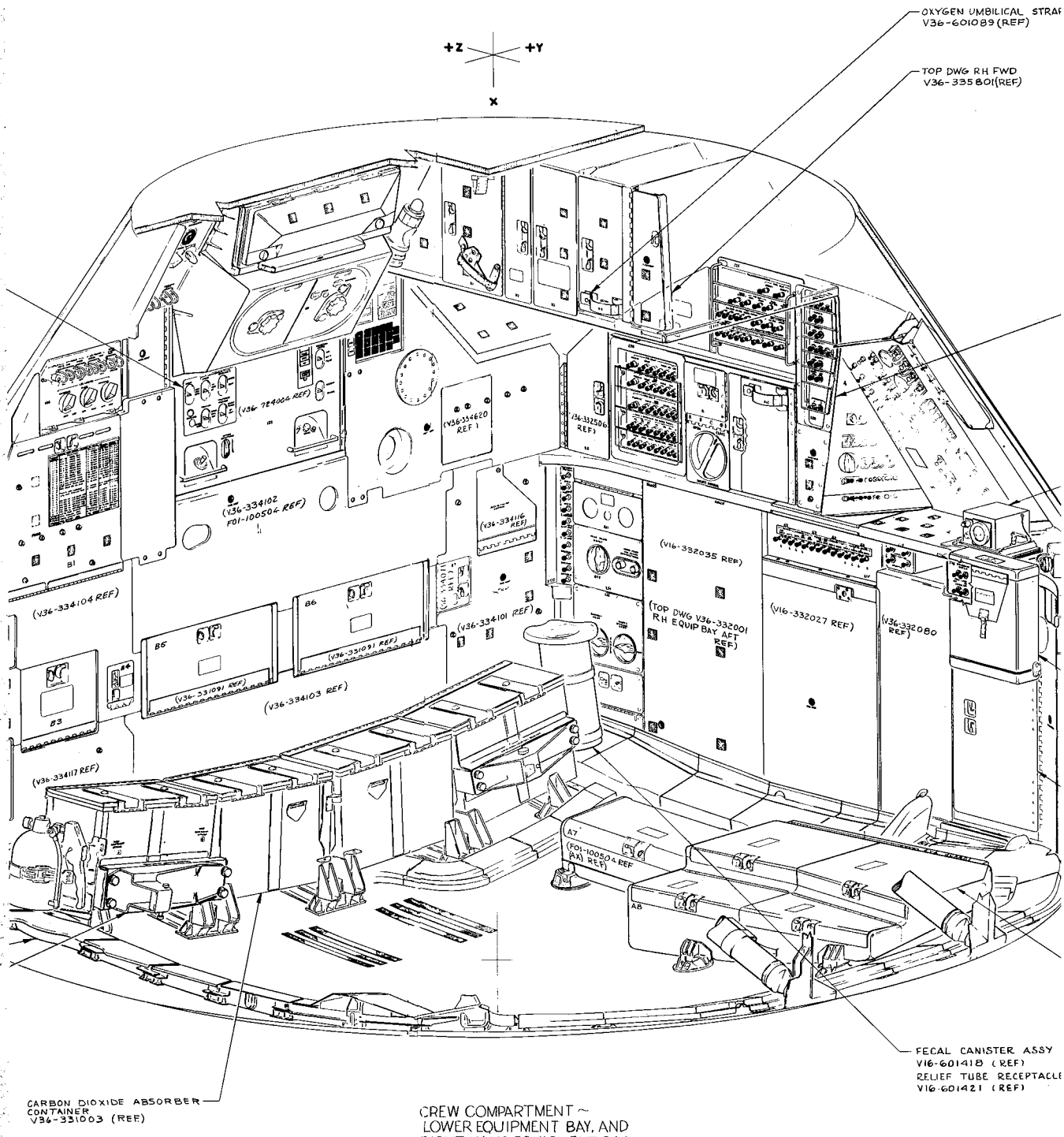
CABIN TEMP CONTROL
PANEL ASSY
V36-610065 (REF)

-POTABLE WATER RESERVOIR
AIRESEARCH 812940 (REF)

-DIGITAL TIMER PANEL NO. 306
V36-764090 (REF)

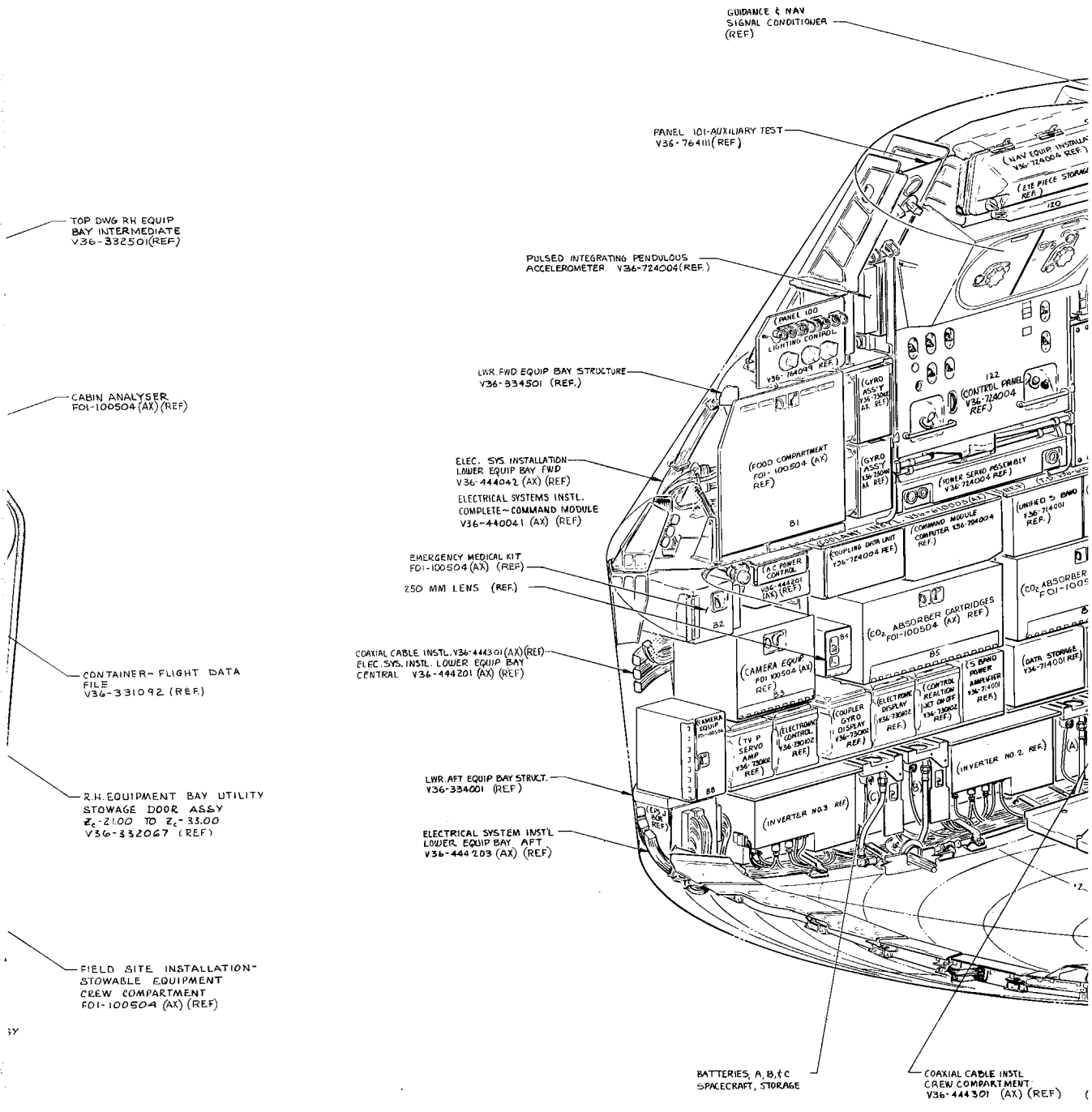






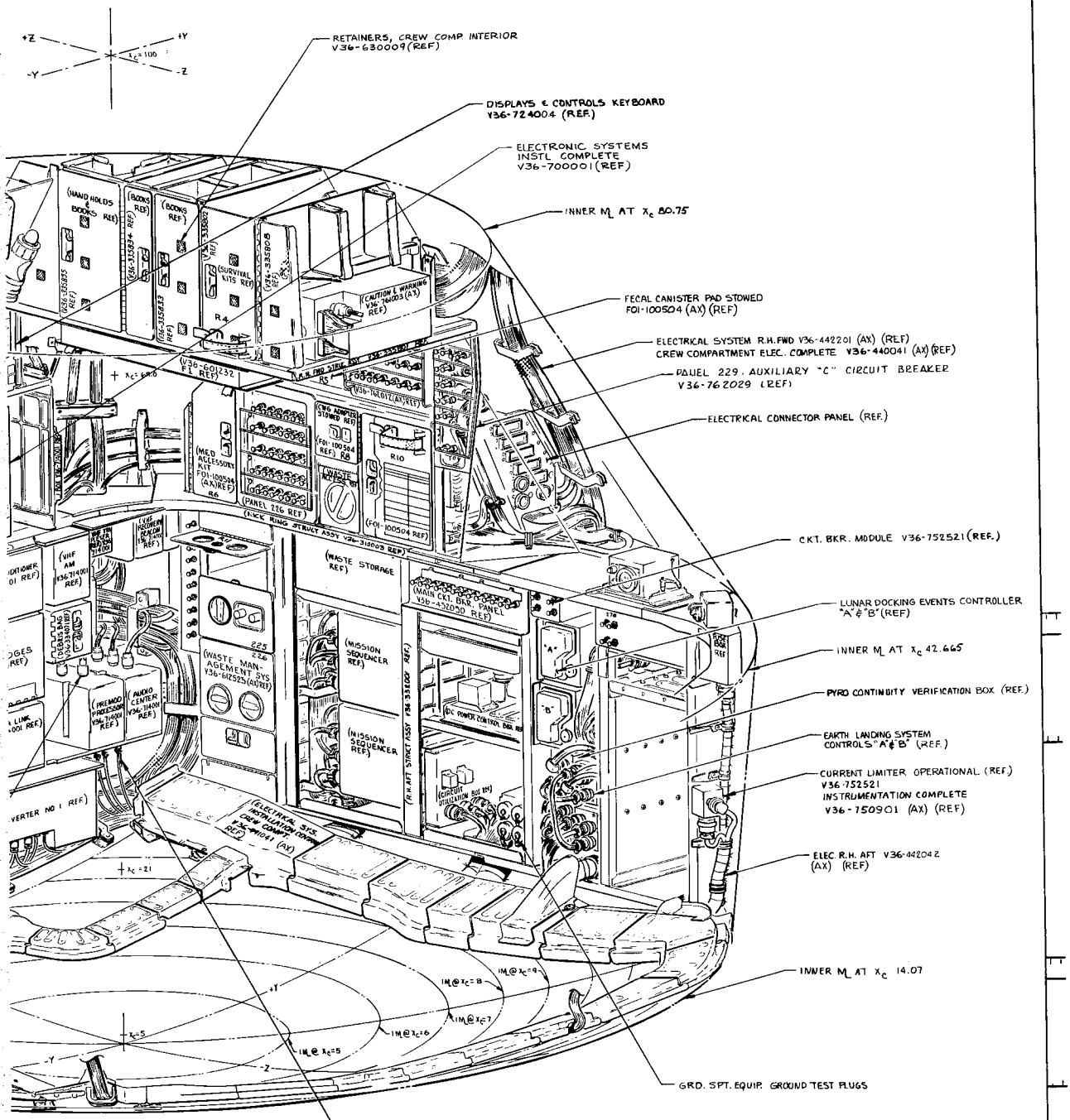
CREW COMPARTMENT ~
LOWER EQUIPMENT BAY, AND
RIGHT HAND EQUIPMENT BAY,
CLOSE-OUT PANELS SHOWN

TL


GUIDANCE & NAV SIGNAL CONDITIONER (REF)
PANEL 101-AUXILIARY TEST V36-764111 (REF)
TOP DWG RH EQUIP BAY INTERMEDIATE V36-332501 (REF)
PULSED INTEGRATING PENDULOUS ACCELEROMETER V36-724004 (REF.)
LWR. FWD EQUIP BAY STRUCTURE V36-334501 (REF.)
CABIN ANALYSER FOI-100504 (AX) (REF)
ELEC. SYS INSTALLATION LOWER EQUIP BAY FWD V36-444042 (AX) (REF)
ELECTRICAL SYSTEMS INSTL. COMPLETE~COMMAND MODULE V36-440041 (AX) (REF)
EMERGENCY MEDICAL KIT FOI-100504 (AX) (REF)
250 MM LENS (REF.)
COAXIAL CABLE INSTL. V36-444301 (AX) (REF) ELEC. SYS. INSTL. LOWER EQUIP BAY CENTRAL V36-444201 (AX) (REF)
CONTAINER~FLIGHT DATA FILE V36-331092 (REF.)
R.H. EQUIPMENT BAY UTILITY STOWAGE DOOR ASSY Zc -21.00 TO Zc -33.00 V36-332067 (REF)
LWR. AFT EQUIP BAY STRUCT. V36-334001 (REF.)
ELECTRICAL SYSTEM INSTL LOWER EQUIP BAY AFT V36-444203 (AX) (REF)
FIELD SITE INSTALLATION~ STOWABLE EQUIPMENT CREW COMPARTMENT FOI-100504 (AX) (REF)
BATTERIES, A, B, & C SPACECRAFT, STORAGE
COAXIAL CABLE INSTL CREW COMPARTMENT V36-444301 (AX) (REF)
(PANEL 100 LIGHTING CONTROL V36-764099 REF.)
(GYRO ASSY V36-73004 AR REF)
122 (CONTROL PANEL V36-724004 REF.)
(FOOD COMPARTMENT FOI-100504 (AX) REF.)
(POWER SERVO ASSEMBLY V36-724004 REF.)
(COUPLING DATA UNIT V36-724004 REF.)
(COMMAND MODULE COMPUTER V36-724004 REF.)
(UNIFIED S BAND V36-714001 REF.)
(A.C. POWER CONTROL V36-444201 (AX) (REF.))
(CO2 ABSORBER CARTRIDGES FOI-100504 (AX) REF)
(CAMERA EQUIP FOI-100504 (AX) REF.)
(DATA STORAGE V36-714001 REF.)
(TV P SERVO AMP V36-73002 REF)
(ELECTRONIC CONTROL V36-73002 REF)
(COUPLER GYRO DISPLAY V36-73002 REF.)
(ELECTRONIC DISPLAY V36-73002 REF.)
(CONTROL REACTION JET ON-OFF V36-73002 REF.)
(S BAND POWER AMPLIFIER V36-714001 REF)
(INVERTER NO.2 REF.)
(INVERTER NO.3 REF)
B1
B2
B3
B4
B5
B6
B7
B8

SHEET 5

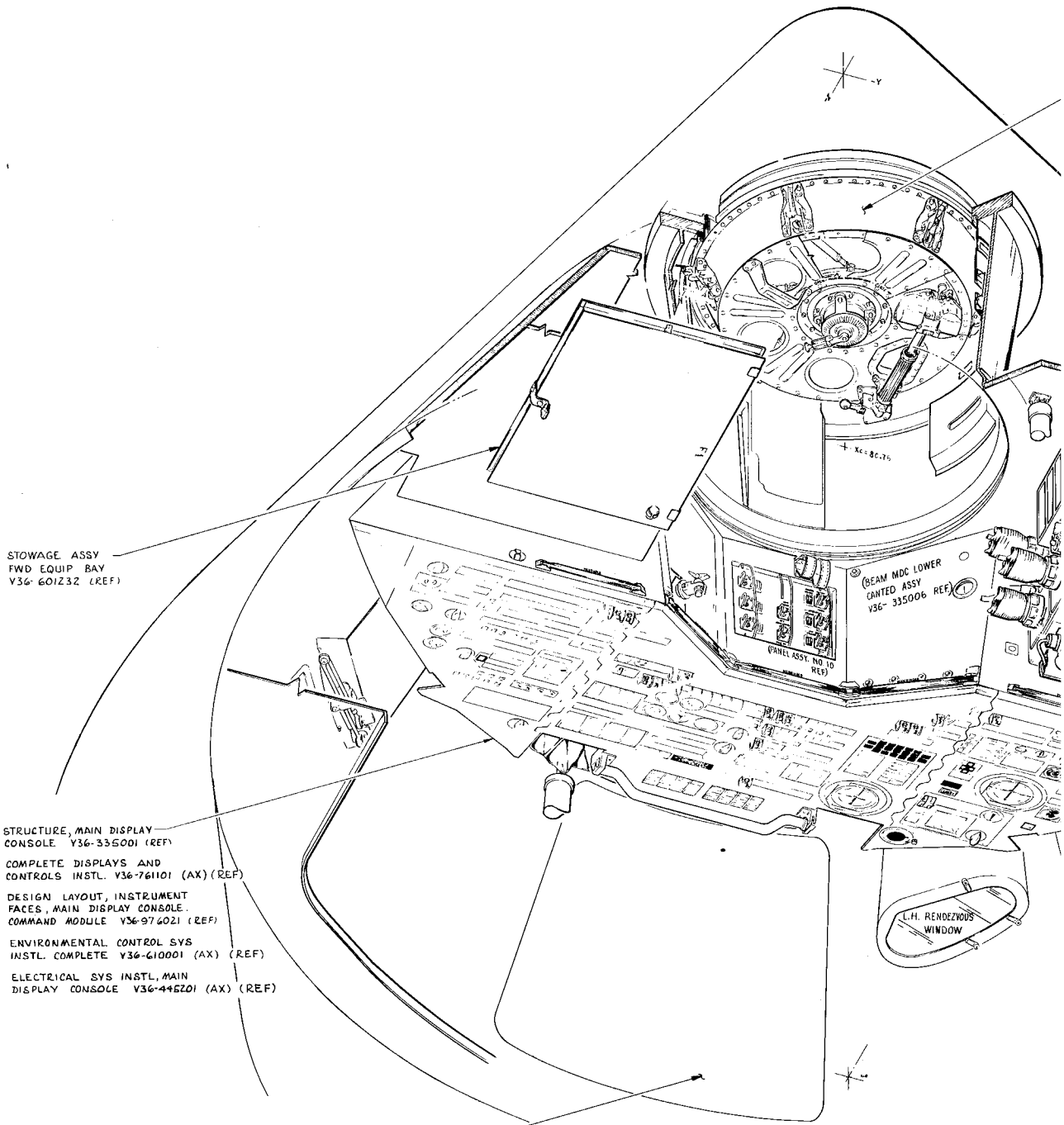
REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED
		1. MAY BE REWORKED 3. RECORD CHANGE 2. CANNOT BE REWORKED 4. NOW SHOP PRACTICE 5. PARTS MADE OK		



CREW COMPARTMENT~
LOWER EQUIPMENT BAY,
AND RIGHT HAND EQUIPMENT BAY
-OUT PANELS OMITTED FOR CLARITY

1.5 STR

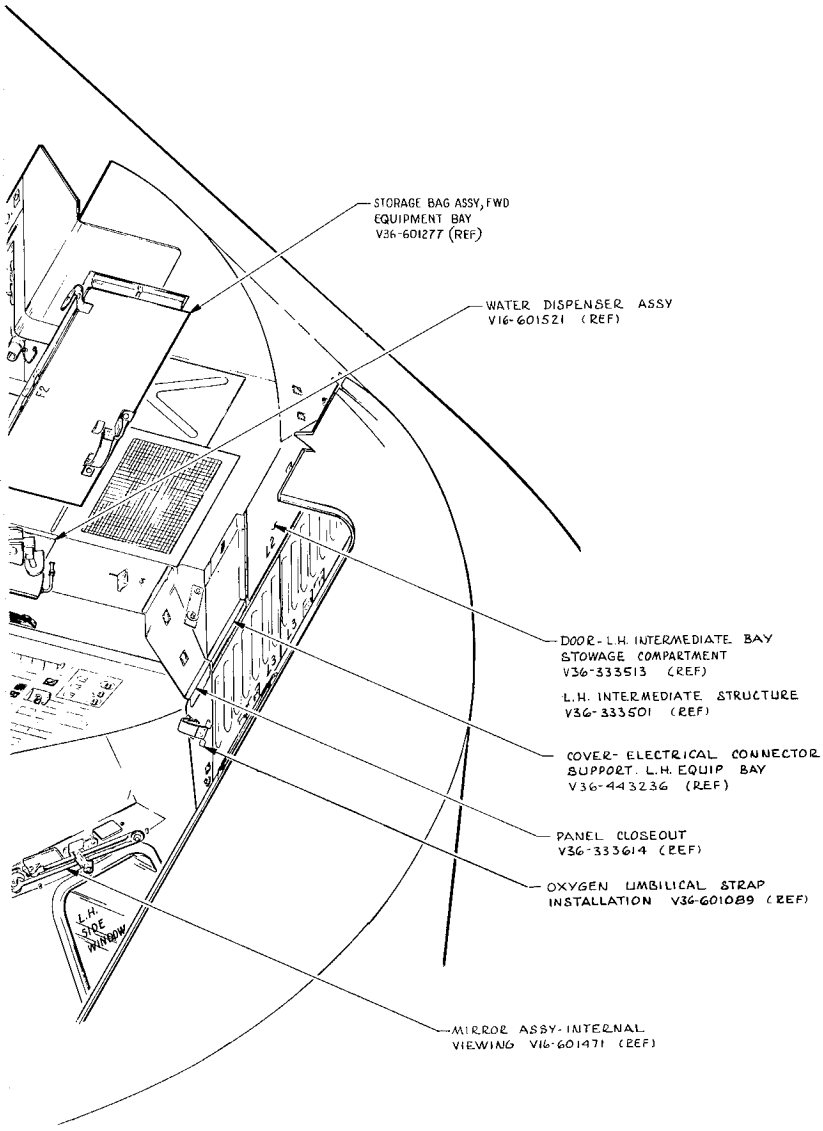
NORTH AMERICAN AVIATION, INC. SPACE and INFORMATION SYSTEMS DIVISION 12214 LAKEWOOD BLVD., DOWNEY, CALIFORNIA		
CODE IDENT NO. 03953	SIZE J	
SCALE NONE		SHEET 5

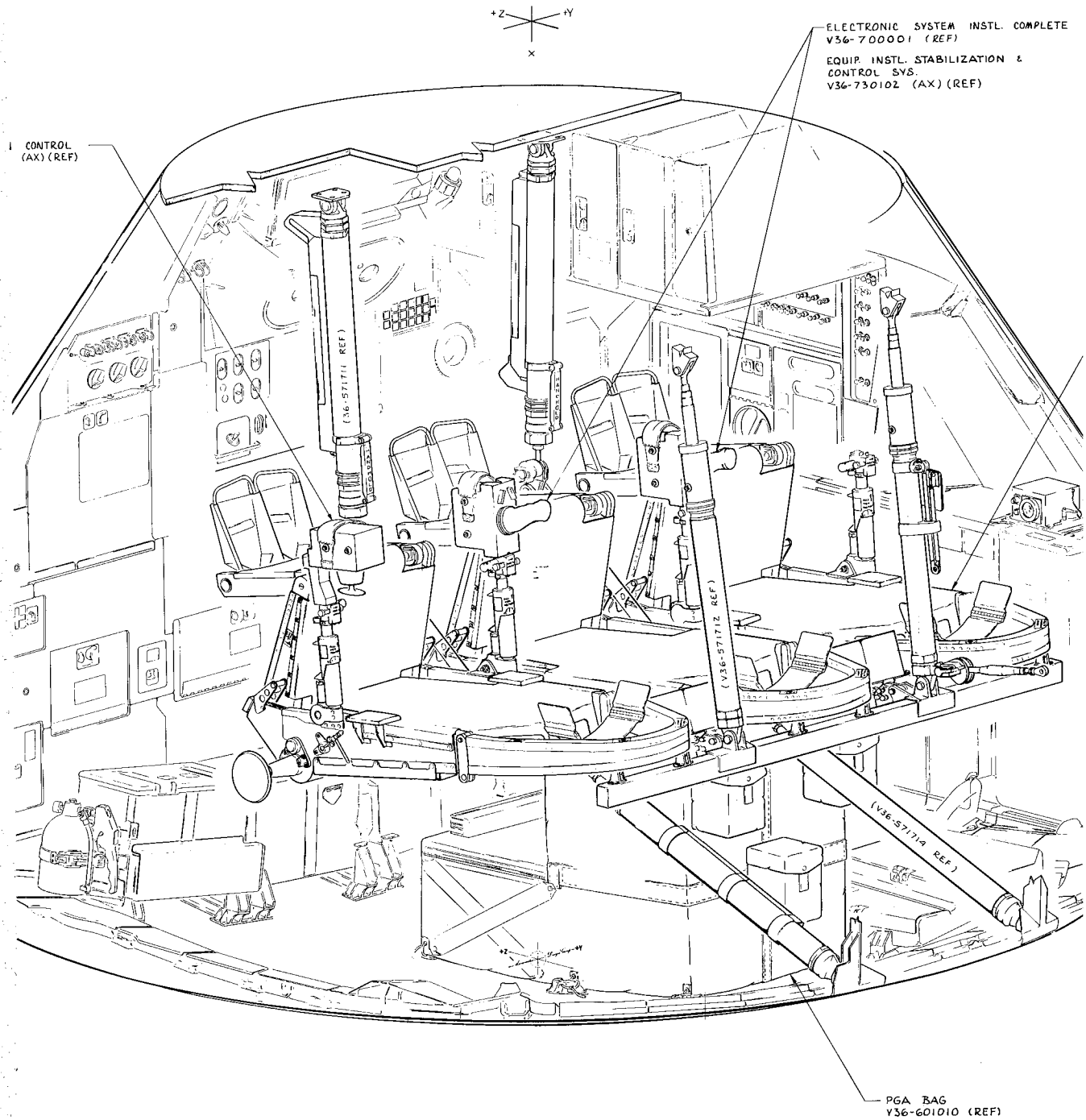


VIEW LOOKING FWD AT
MAIN DISPLAY CONSOLE,
FORWARD BULKHEAD, FWD HATCH,
UPPER SIDE WALL, MAIN CREW
HATCH, L.H. WINDOWS, L.H.
FWD AND INTERMEDIATE EQUIP BAYS

FORWARD CREW HATCH
V36-326601 (AX) (REF)

TRANSL
V36-73





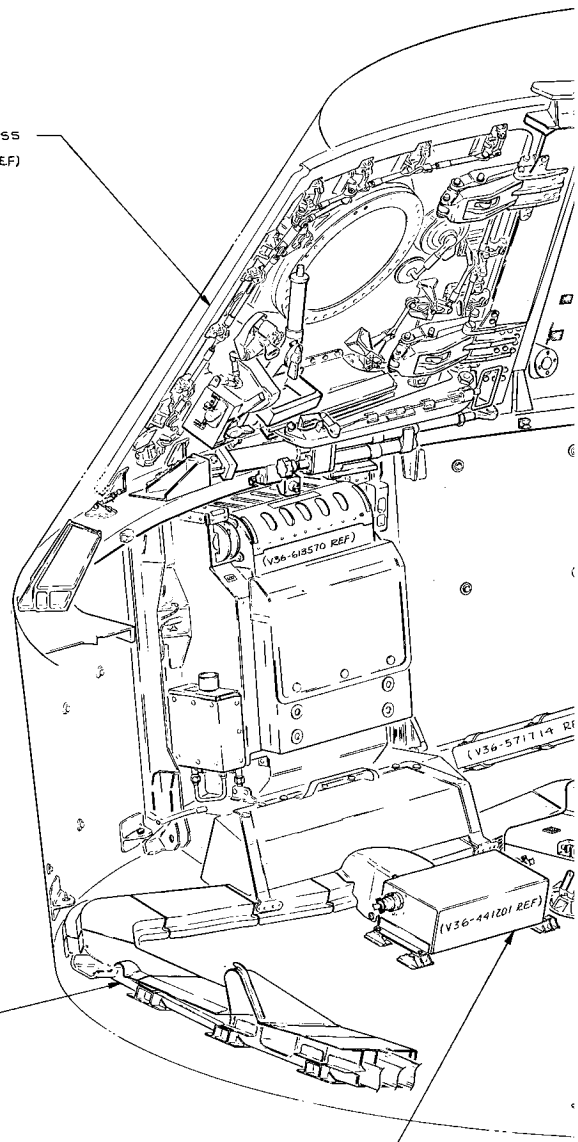
VIEW LOOKING DOWN & INBOARD
FOLDABLE CREW COUCHES

16MM ACQUISITION CAMERA ADAPTER INSTL V36-753016 (AX)(REF)

UNIFIED CREW ACCESS HATCH INSTL V36-311189 (AX) (REF)

CREW COUCH SUBSYSTEM MH01-60016 (REF)

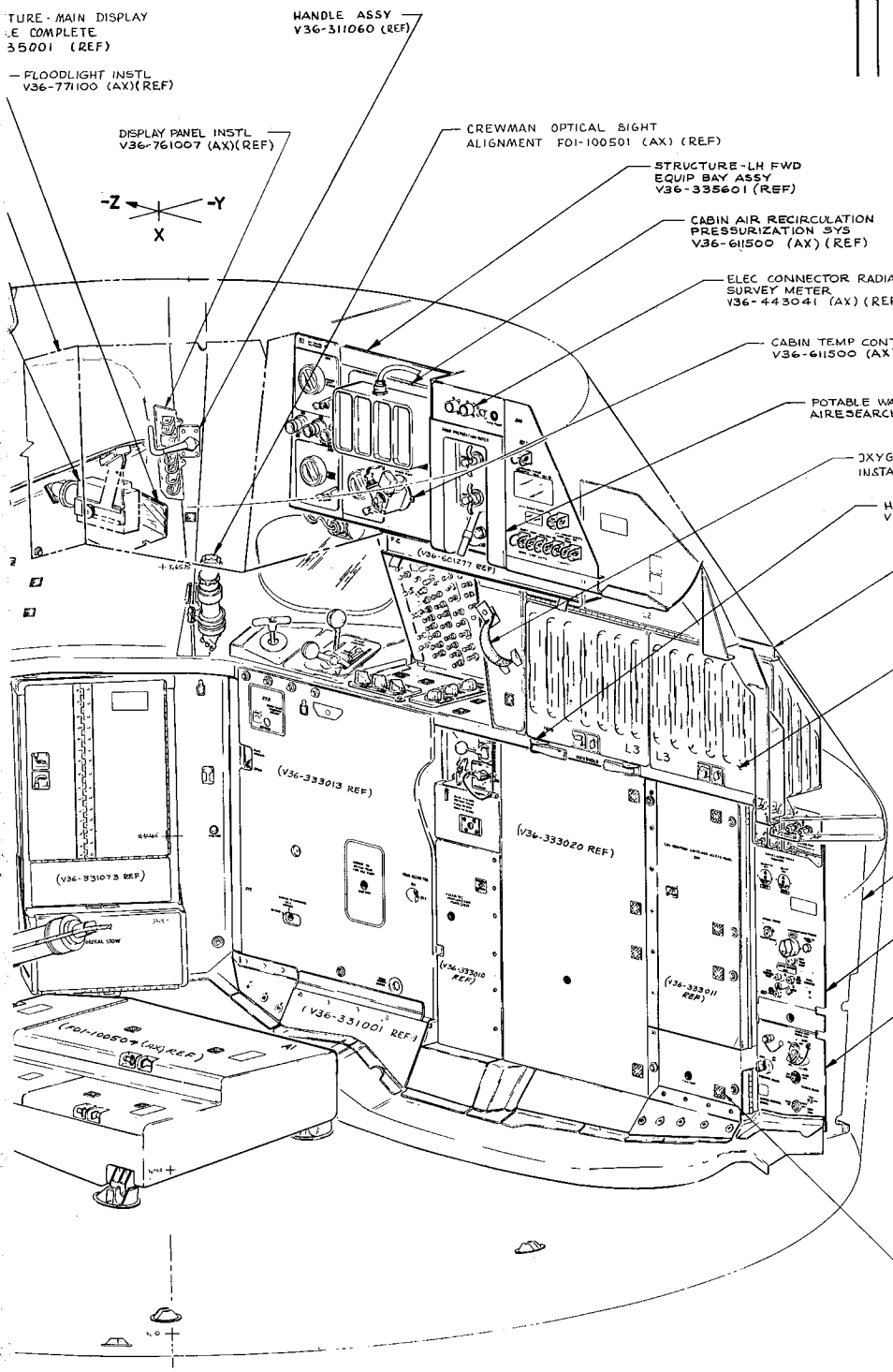
CREW SUPPORT ASSEMBLY FOLDABLE COUCH SEE WEBER DWG 811202 (REF)



WIREWAY INSTL AFT BULKHD V36-441300 (AX)(REF)

SCS JUNCTION BOX ASSY V36-441041 (AX)(REF)

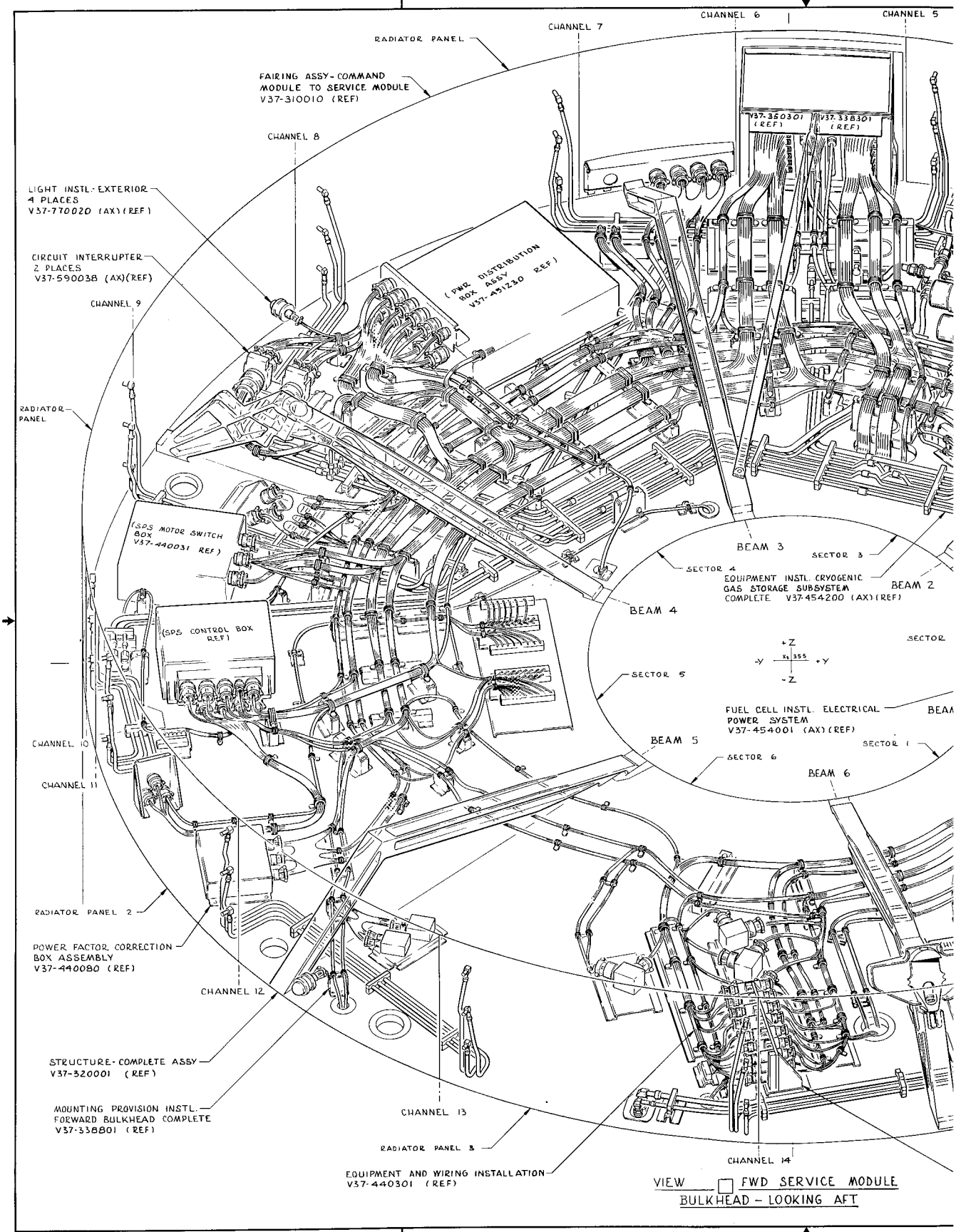
REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED
		1. MAY BE REWORKED 3. RECORD CHANGE 2. CANNOT BE REWORKED 4. NOW SHOP PRACTICE 5 PARTS MADE OK		



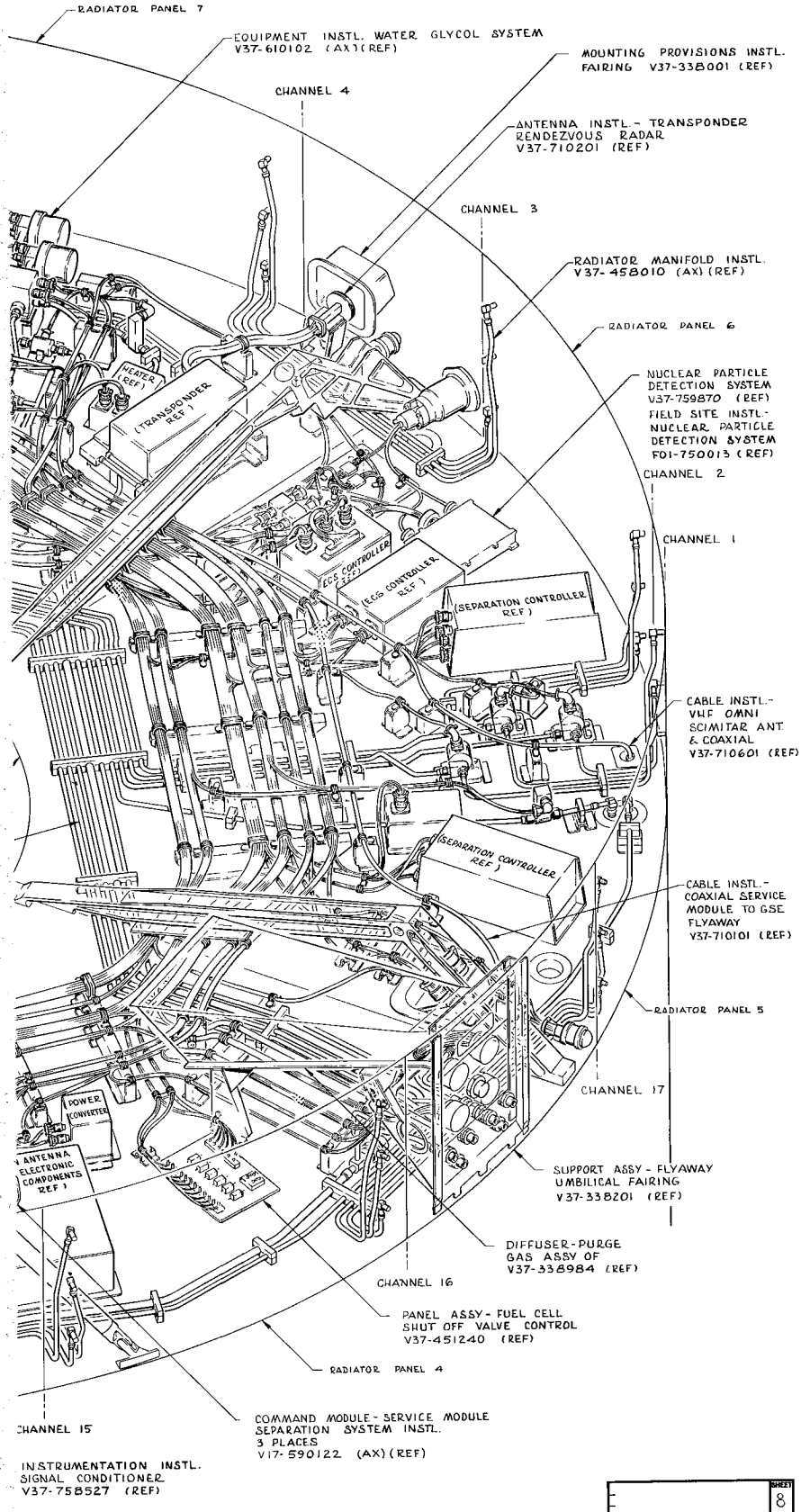
CREW COMPARTMENT
LEFT HAND EQUIPMENT BAY
AND CREW HATCH AREA
CENTRAL CREW COMPARTMENT

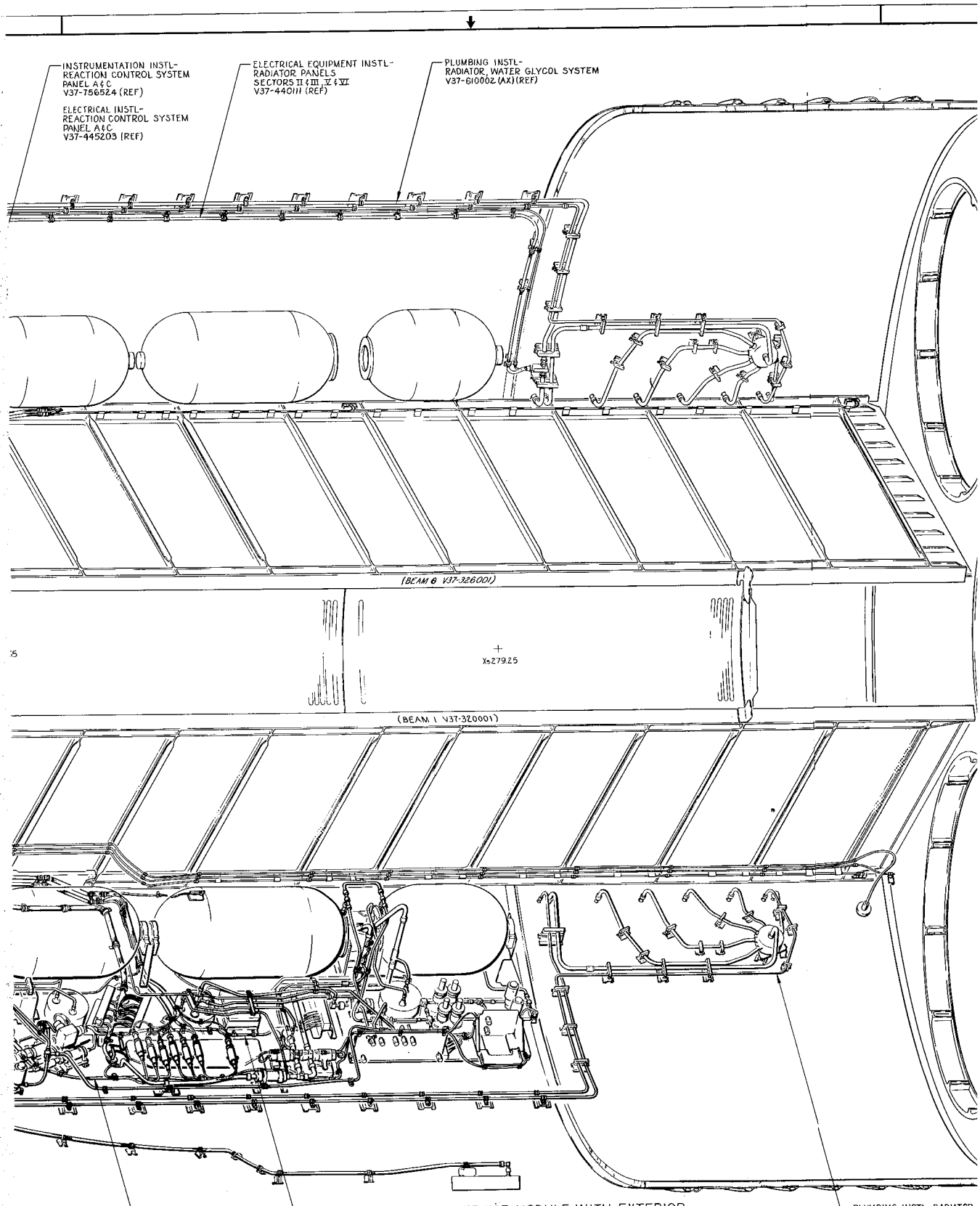
1.6 STR

NORTH AMERICAN AVIATION, INC. SPACE and INFORMATION SYSTEMS DIVISION 12214 LAKEWOOD BLVD., DOWNEY, CALIFORNIA		
CODE IDENT NO. 03953	SIZE J	
SCALE NONE		SHEET 6

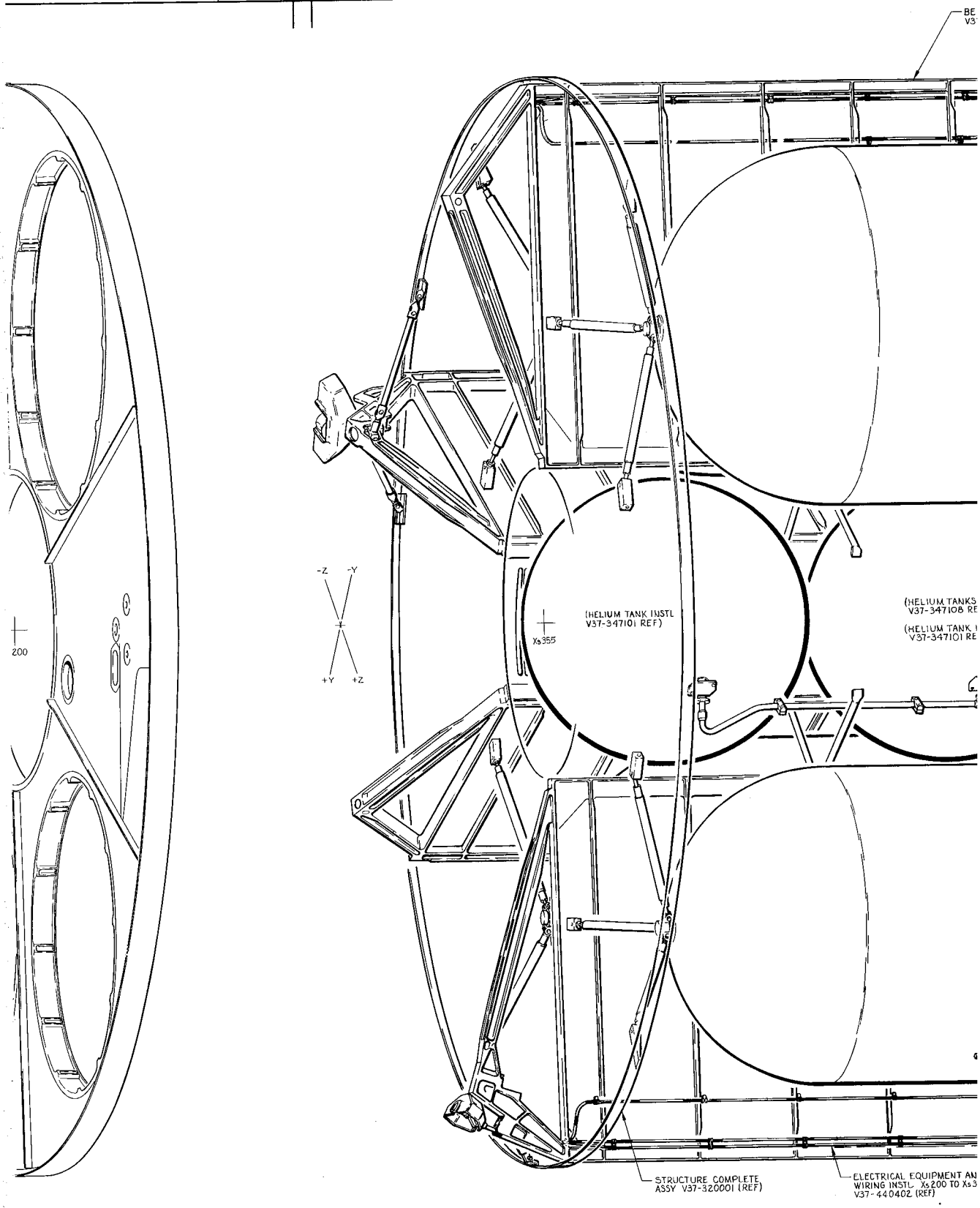


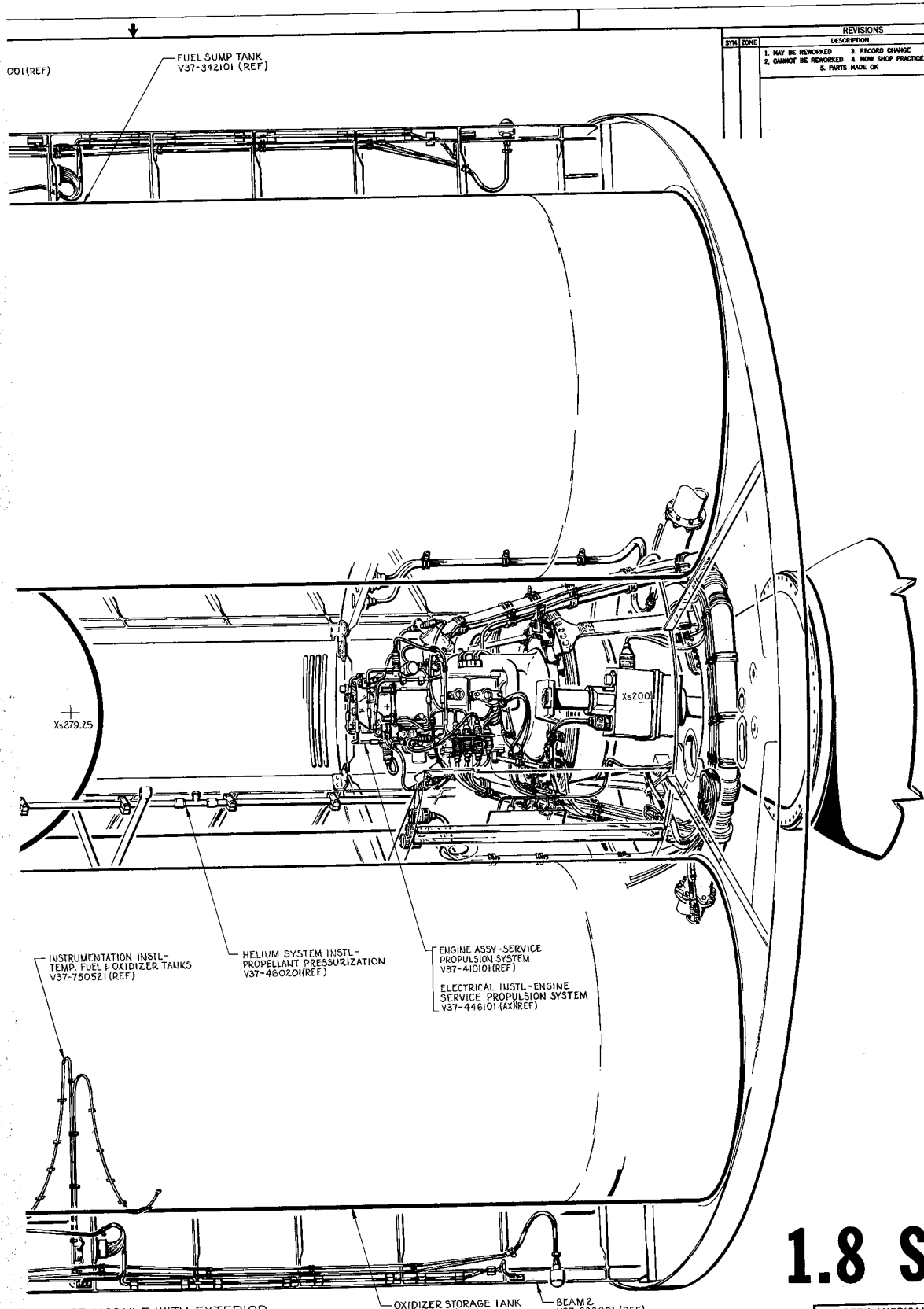
VIEW ☐ FWD SERVICE MODULE
BULKHEAD – LOOKING AFT


RADIATOR PANEL 7
EQUIPMENT INSTL. WATER GLYCOL SYSTEM V37-610102 (AX)(REF)
MOUNTING PROVISIONS INSTL. FAIRING V37-338001 (REF)
CHANNEL 4
ANTENNA INSTL - TRANSPONDER RENDEZVOUS RADAR V37-710201 (REF)
CHANNEL 3
RADIATOR MANIFOLD INSTL. V37-458010 (AX) (REF)
RADIATOR PANEL 6
NUCLEAR PARTICLE DETECTION SYSTEM V37-759870 (REF)
FIELD SITE INSTL- NUCLEAR PARTICLE DETECTION SYSTEM F01-750013 (REF)
CHANNEL 2
CHANNEL 1
CABLE INSTL- VHF OMNI SCIMITAR ANT & COAXIAL V37-710601 (REF)
CABLE INSTL- COAXIAL SERVICE MODULE TO GSE FLYAWAY V37-710101 (REF)
RADIATOR PANEL 5
CHANNEL 17
SUPPORT ASSY - FLYAWAY UMBILICAL FAIRING V37-338201 (REF)
DIFFUSER-PURGE GAS ASSY OF V37-338984 (REF)
CHANNEL 16
PANEL ASSY - FUEL CELL SHUT OFF VALVE CONTROL V37-451240 (REF)
RADIATOR PANEL 4
COMMAND MODULE - SERVICE MODULE SEPARATION SYSTEM INSTL. 3 PLACES V17-590122 (AX)(REF)
CHANNEL 15
INSTRUMENTATION INSTL. SIGNAL CONDITIONER V37-758527 (REF)
HEATER (REF)
TRANSPONDER (REF)
ECS CONTROLLER (REF)
ECS CONTROLLER (REF)
SEPARATION CONTROLLER (REF)
SEPARATION CONTROLLER (REF)
POWER CONVERTER
ANTENNA ELECTRONIC COMPONENTS (REF)
-Z
-Y
+Y
+Z
CABLE INSTL-VHF OMNI SCIMITAR ANTENNA AND COAXIAL V37-710601 (AX)(REF)



SERVICE MODULE WITH EXTERIOR PANELS, BEAMS 2,3,4,5 AND TANKS REMOVED FOR CLARITY


BE
V3
-Z
-Y
+Y
+Z
(HELIUM TANK INSTL
V37-347101 REF)
Xs355
(HELIUM TANKS
V37-347108 RE
(HELIUM TANK
V37-347101 RE
200
STRUCTURE COMPLETE
ASSY V37-320001 (REF)
ELECTRICAL EQUIPMENT AN
WIRING INSTL Xs200 TO Xs3
V37-440402 (REF)



SERVICE MODULE WITH EXTERIOR PANELS AND BEAMS 3 AND 4 REMOVED FOR CLARITY

1.8 STR

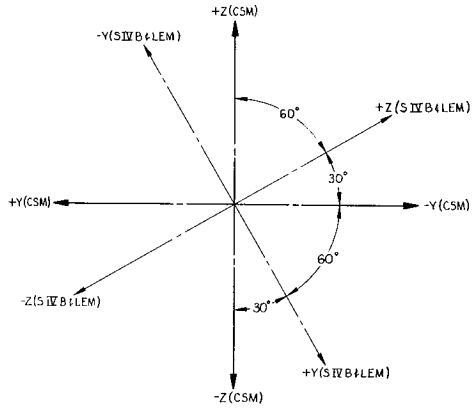
REVISIONS

SYM	ZONE	DESCRIPTION	DATE	APPROVED
		1. MAY BE REWORKED 3. RECORD CHANGE 2. CANNOT BE REWORKED 4. NOW SHOP PRACTICE 5. PARTS MADE OK		

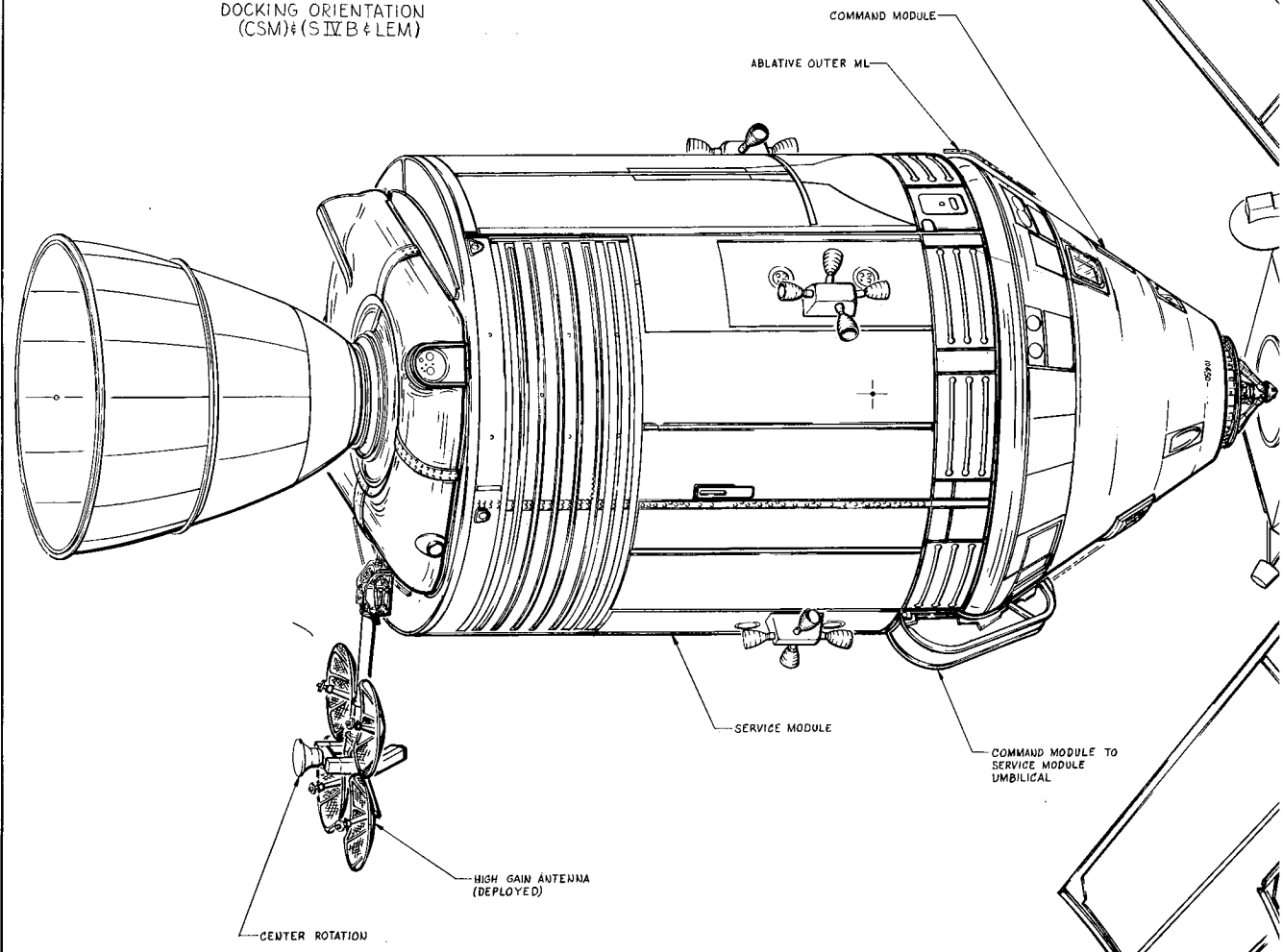
NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION
12214 LAKEWOOD BLVD., DOWNEY, CALIFORNIA

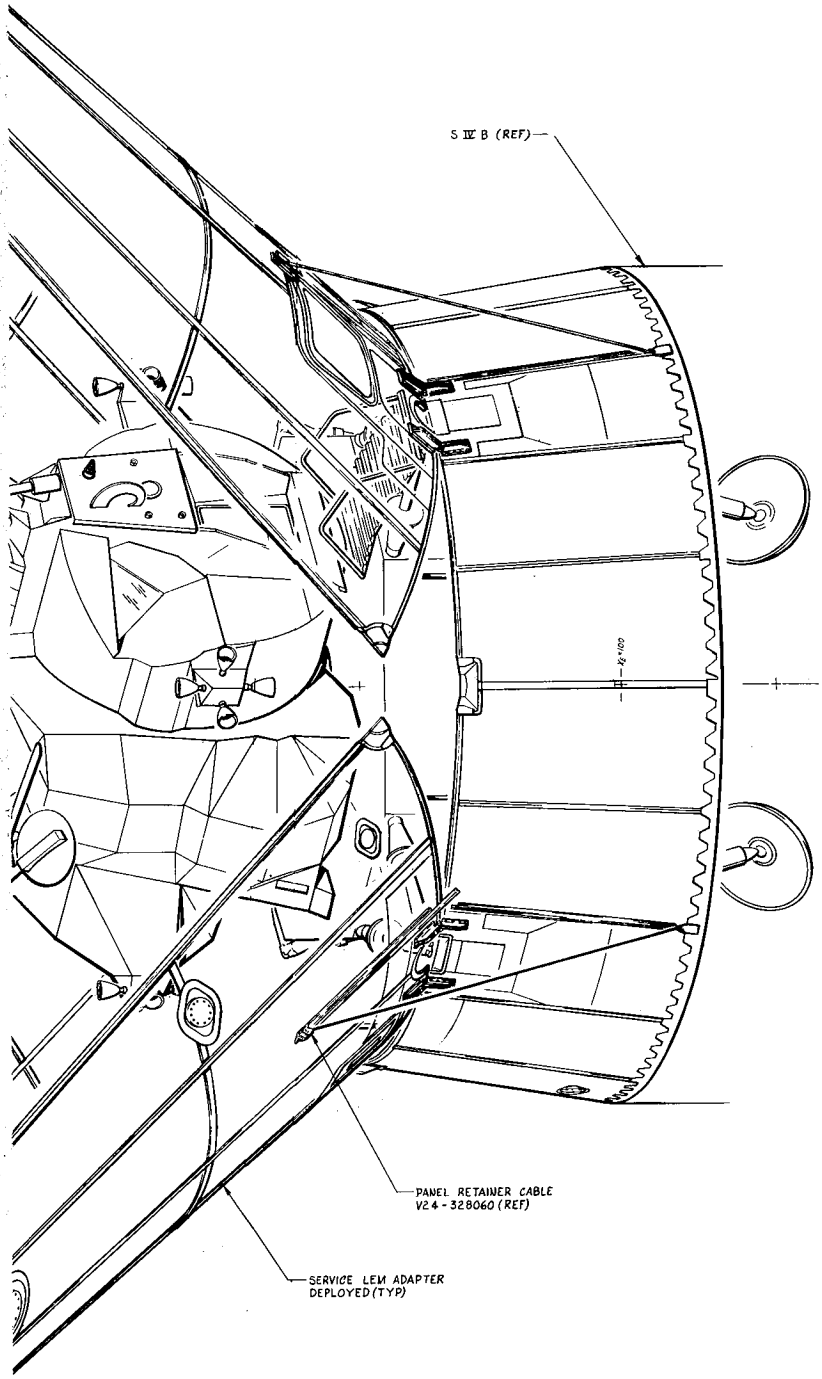
CODE IDENT NO.	SIZE
03953	J

SCALE NONE | DR BY R.M.KELLAR | SHEET 6



DOCKING ORIENTATION
(CSM)+(SIVB+LEM)



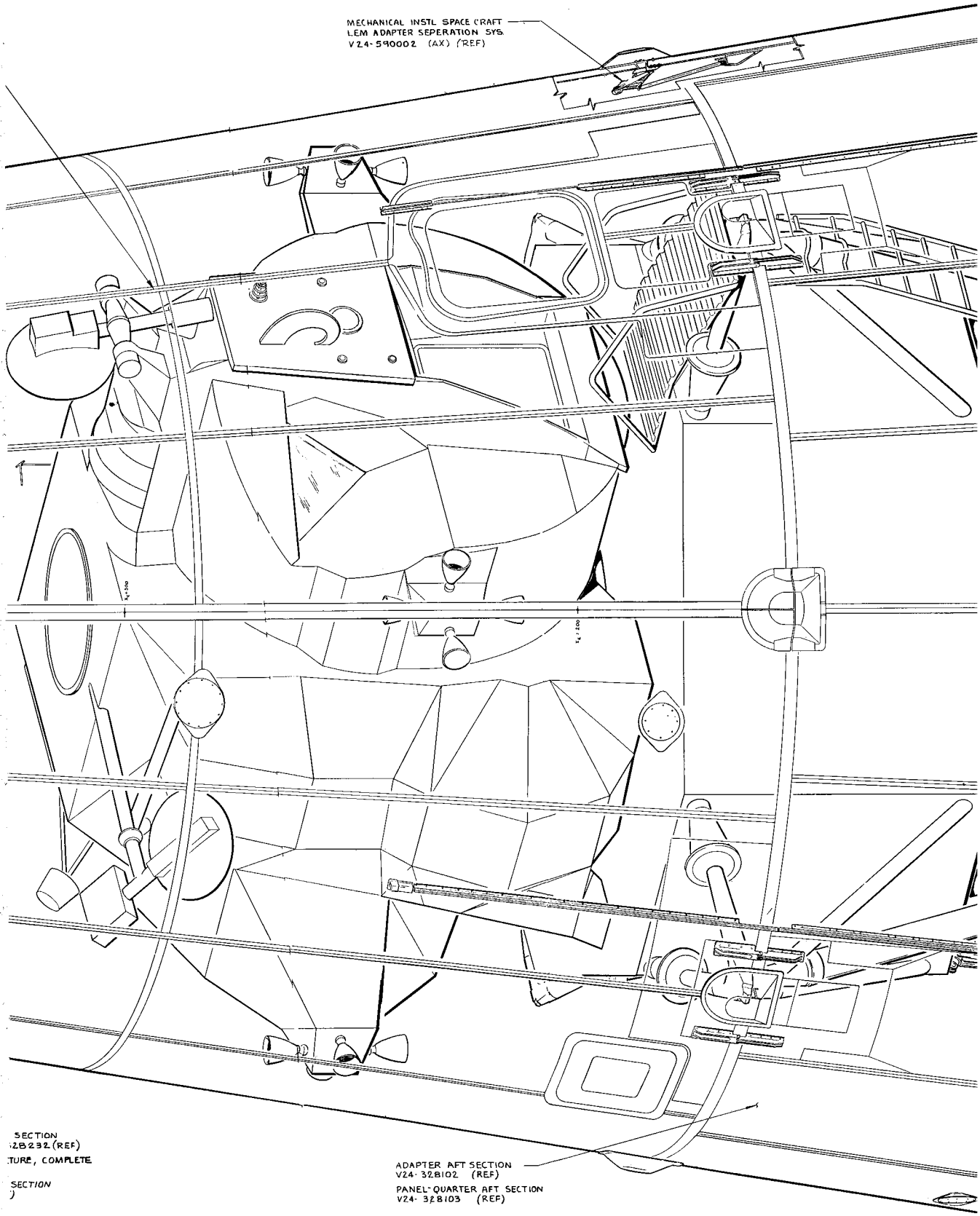


ELECTRICAL SYSTEM SUPPORT
8V24-323001 (REF)

WIRE BUNDLE INSTL
8V24-790064 (REF)

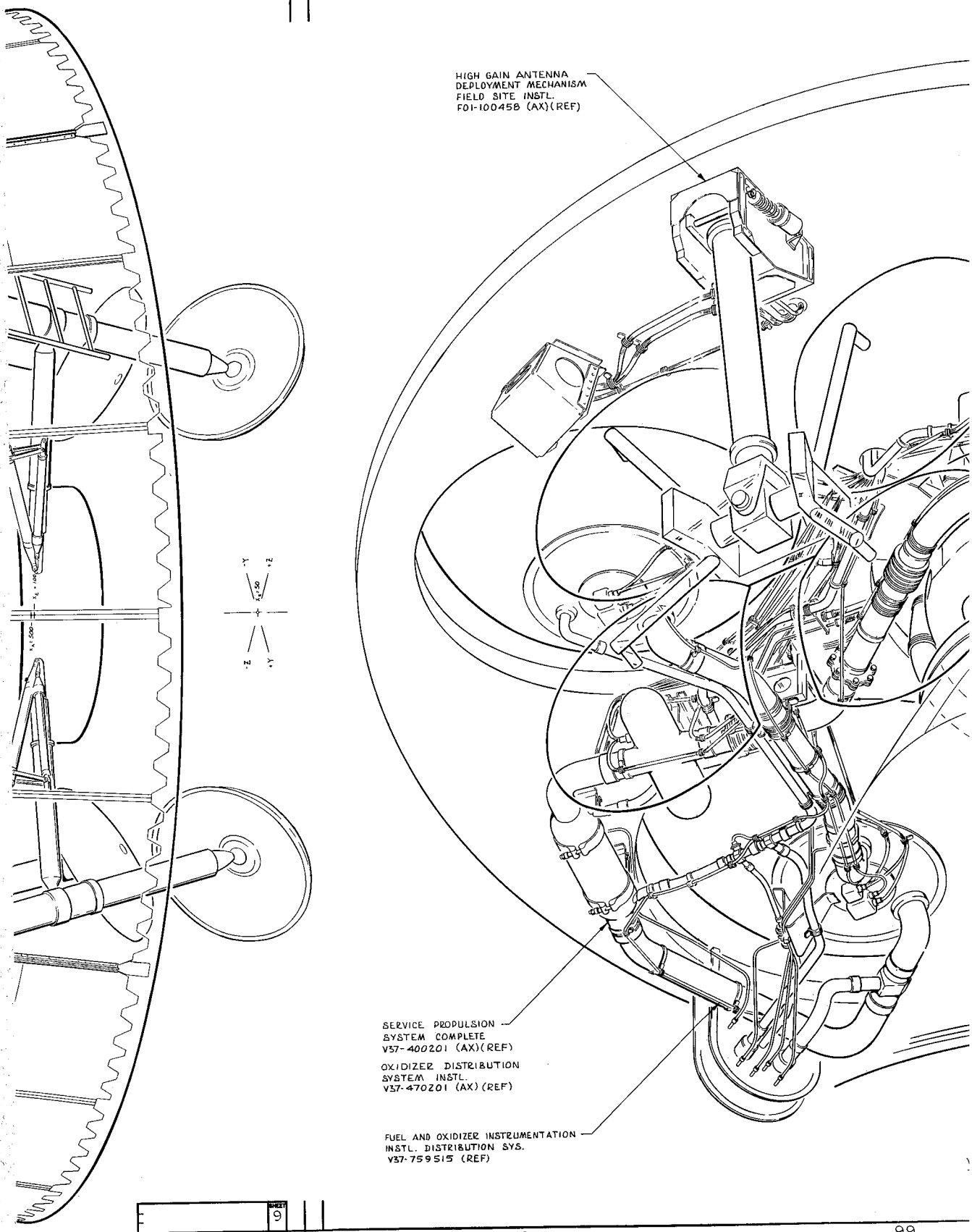
GENERAL ASSY
V24-008002 (
PANEL-QUARTE
V24-328231,
ADAPTER ASSY
V24-328003
ADAPTER ASSY
V24-328238

SHEET 9



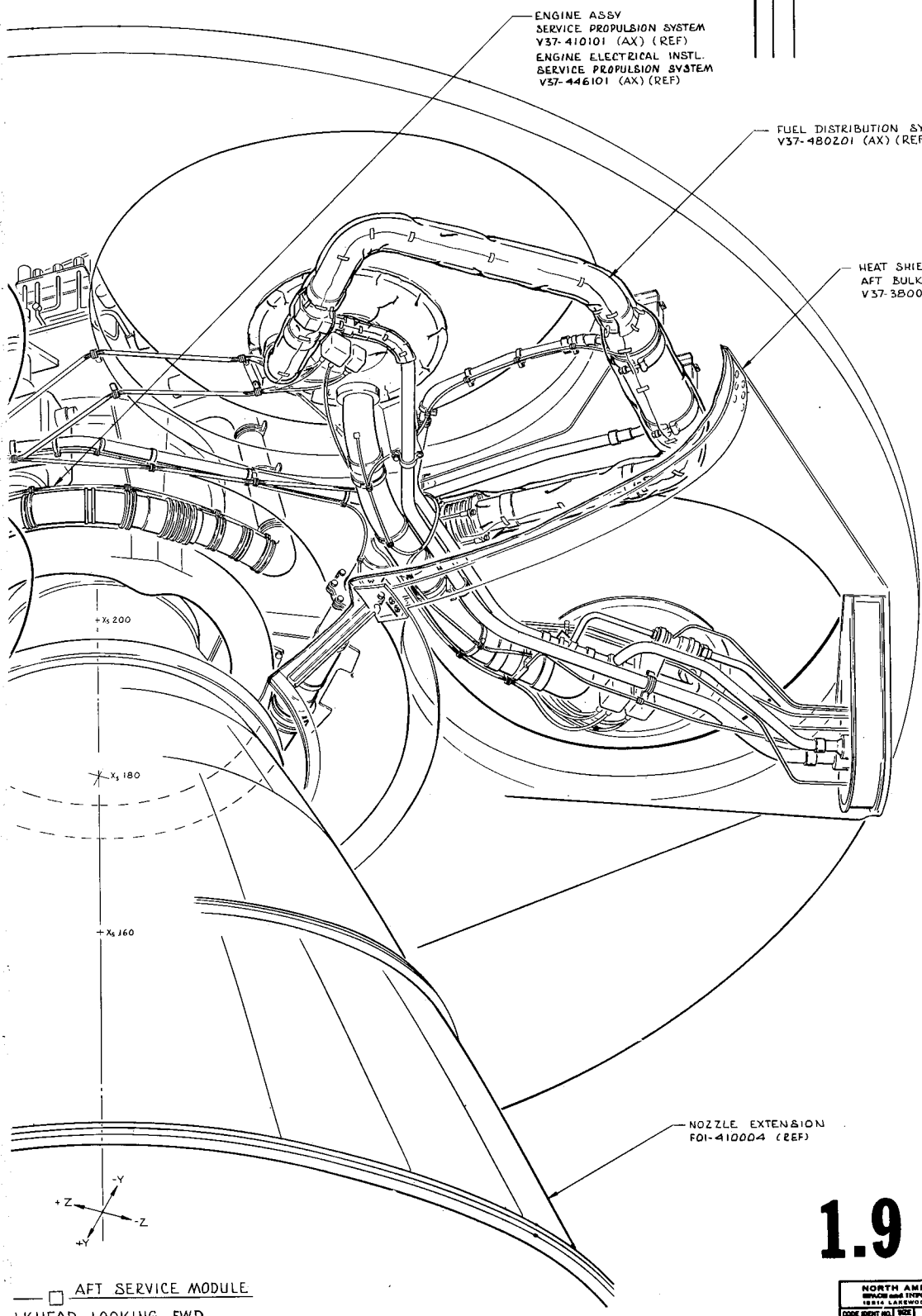
SECTION
·28232 (REF)
:TURE, COMPLETE

SECTION
)


HIGH GAIN ANTENNA
DEPLOYMENT MECHANISM
FIELD SITE INSTL.
F01-100458 (AX)(REF)
SERVICE PROPULSION
SYSTEM COMPLETE
V37-400201 (AX)(REF)
OXIDIZER DISTRIBUTION
SYSTEM INSTL.
V37-470201 (AX)(REF)
FUEL AND OXIDIZER INSTRUMENTATION
INSTL. DISTRIBUTION SYS.
V37-759515 (REF)

98 97

REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED
		1. MAY BE REWORKED 3. RECORD CHANGE 2. CANNOT BE REWORKED 4. NOW SHOP PRACTICE 5. PARTS MADE OK		



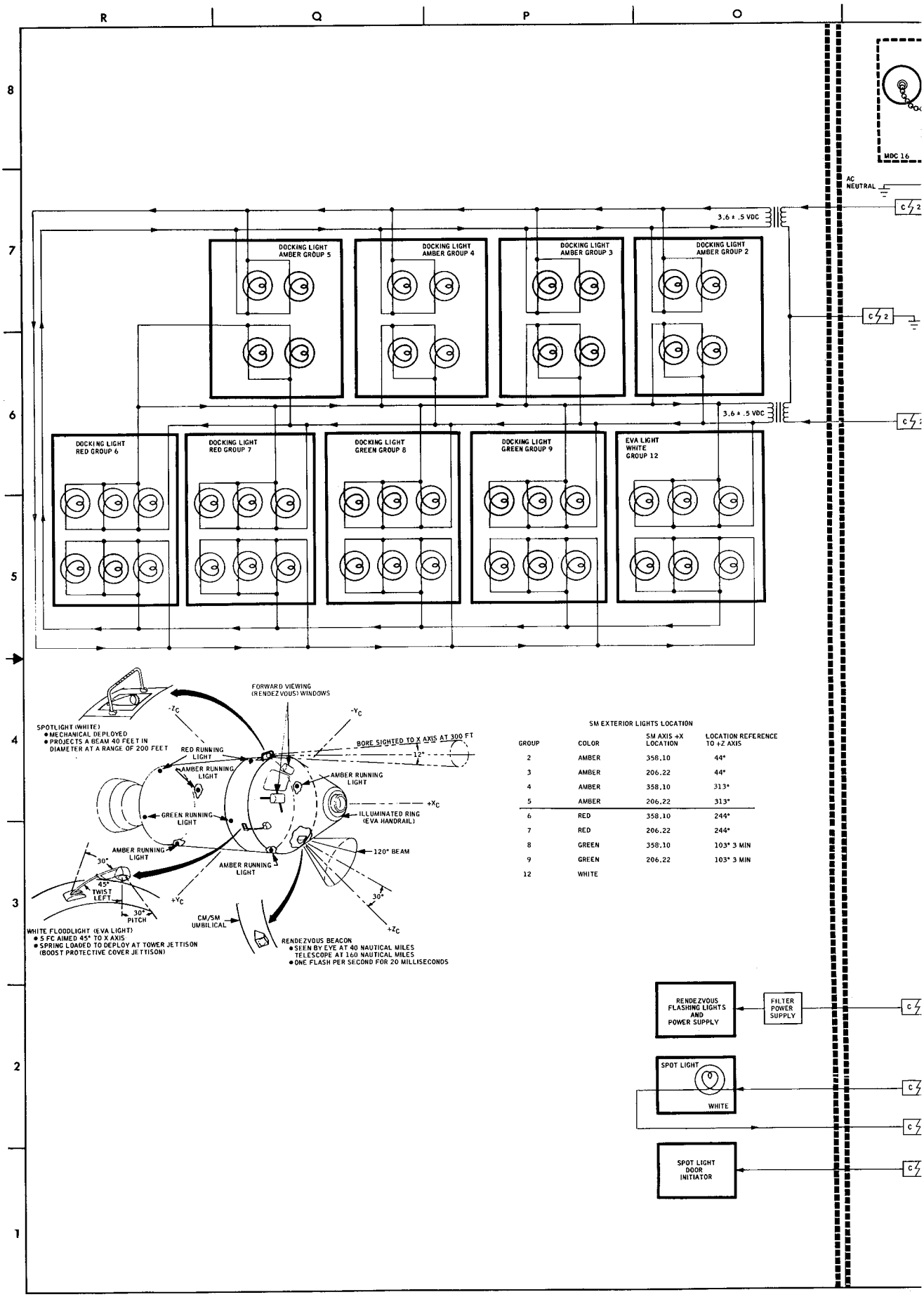
AFT SERVICE MODULE
LKHEAD LOOKING FWD

1.9 STR

NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION
12214 LAKEWOOD BLVD., DOWNEY, CALIFORNIA

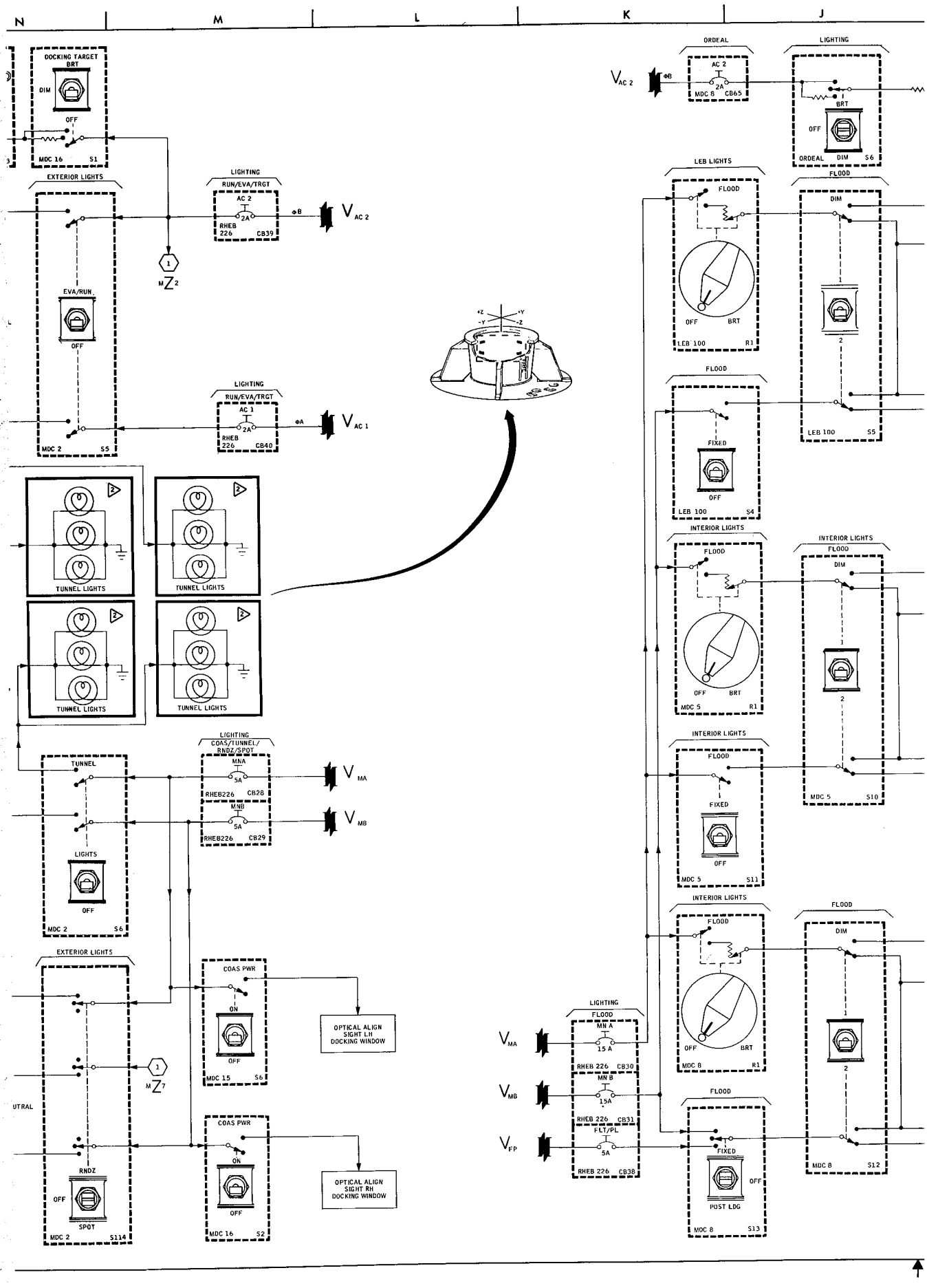
CODE IDENT NO.	SIZE	
03953	J	
SCALE NONE		SHEET 9

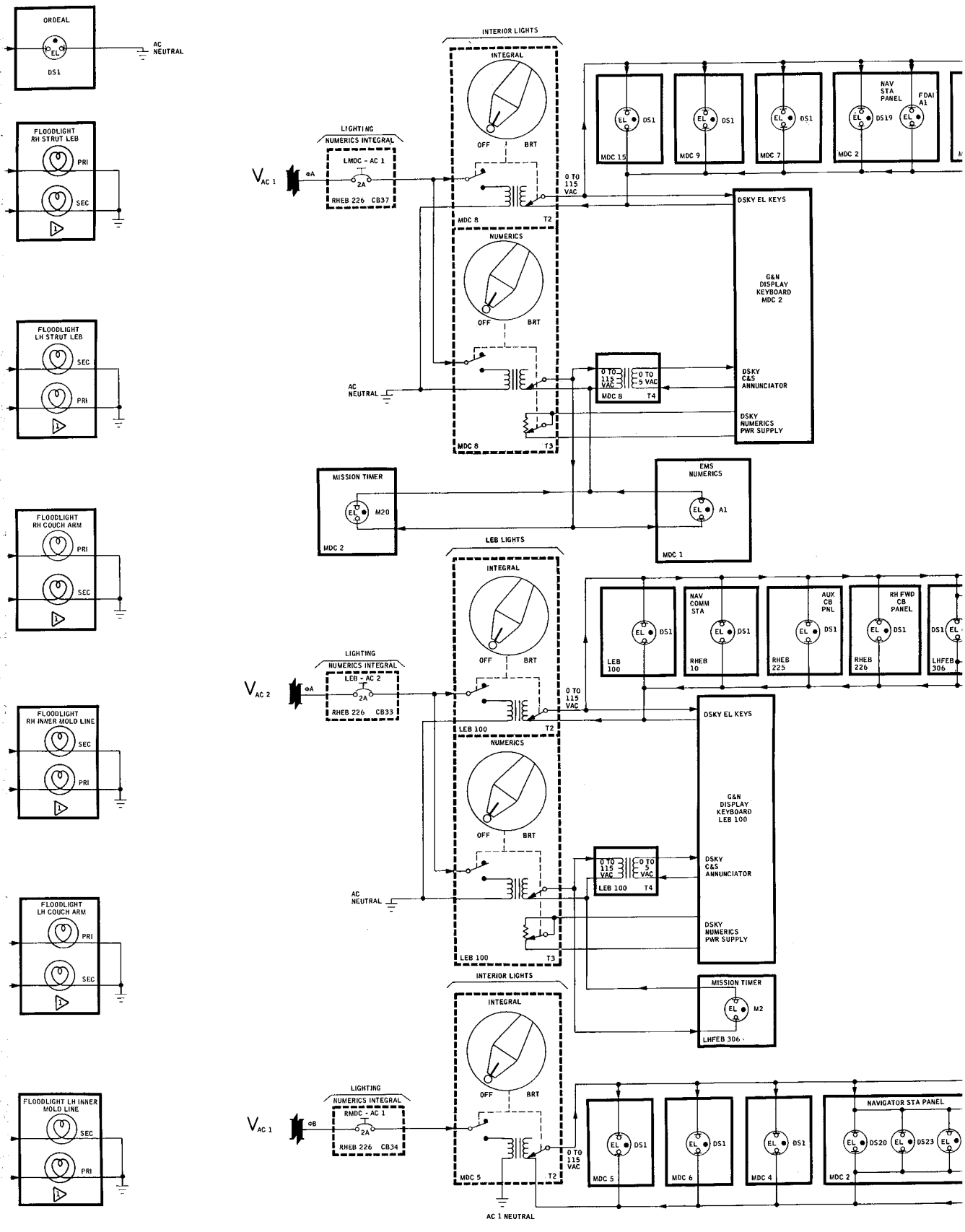
98 97



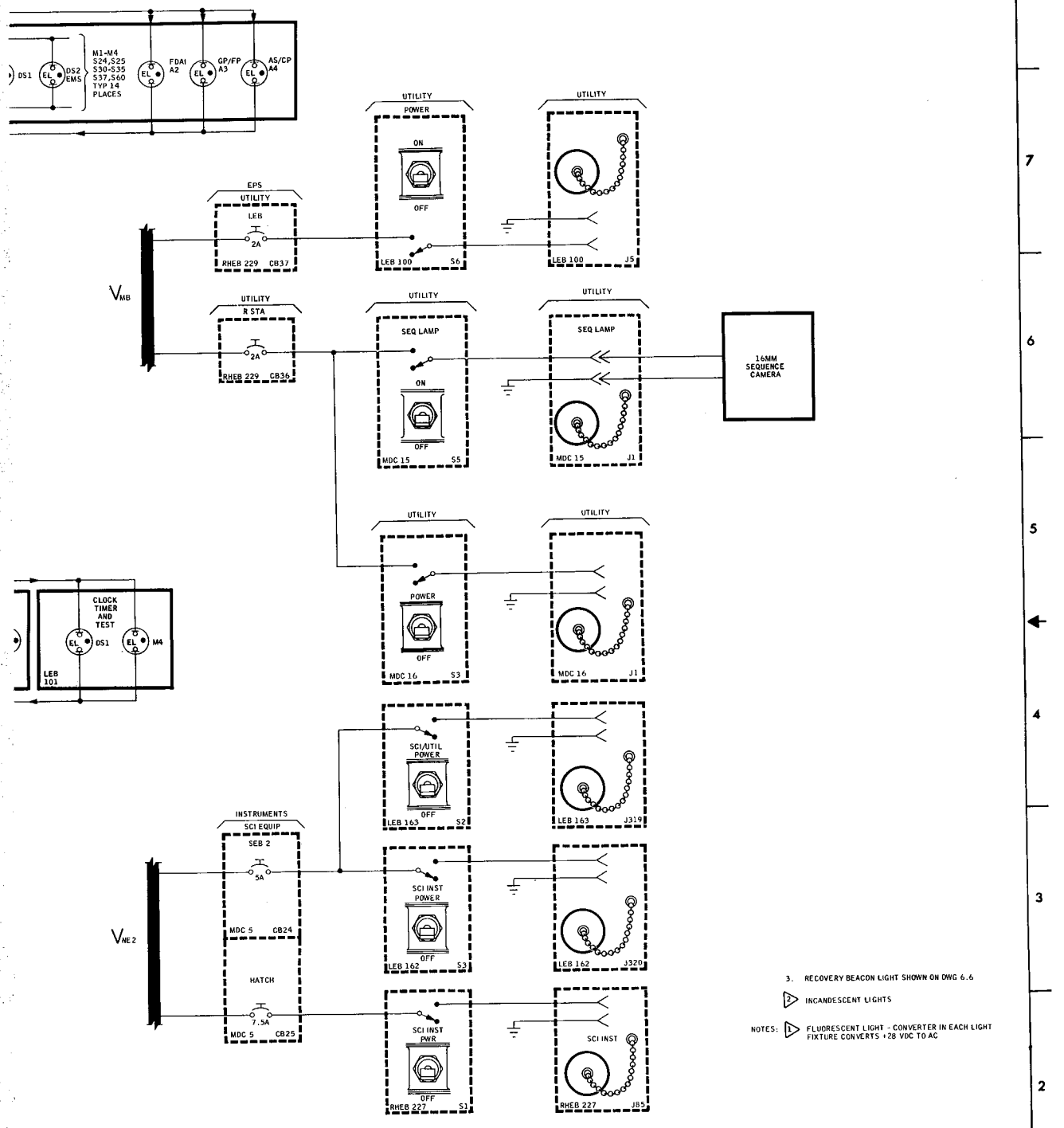
SM EXTERIOR LIGHTS LOCATION

GROUP	COLOR	SM AXIS +X LOCATION	LOCATION REFERENCE TO +Z AXIS
2	AMBER	358.10	44°
3	AMBER	206.22	44°
4	AMBER	358.10	313°
5	AMBER	206.22	313°
6	RED	358.10	244°
7	RED	206.22	244°
8	GREEN	358.10	103° 3 MIN
9	GREEN	206.22	103° 3 MIN
12	WHITE		


N
M
L
K
J
DOCKING TARGET
BRT
DIM
OFF
MDC 16 S1
EXTERIOR LIGHTS
EVA/RUN
OFF
MDC 2 S5
LIGHTING
RUN/EVA/TRGT
AC 2
2A
RHEB 226 CB39
ΦB
$V_{AC\,2}$
LIGHTING
RUN/EVA/TRGT
AC 1
2A
RHEB 226 CB40
ΦA
$V_{AC\,1}$
1
MZ2
TUNNEL LIGHTS
TUNNEL LIGHTS
TUNNEL LIGHTS
TUNNEL LIGHTS
LIGHTING
COAS/TUNNEL/
RNDZ/SPOT
MNA
5A
RHEB226 CB28
V_{MA}
MNB
5A
RHEB226 CB29
V_{MB}
TUNNEL
LIGHTS
OFF
MDC 2 S6
EXTERIOR LIGHTS
RNDZ
OFF
SPOT
MDC 2 S114
1
MZ7
COAS PWR
ON
OFF
MDC 15 S6
OPTICAL ALIGN
SIGHT LH
DOCKING WINDOW
COAS PWR
ON
OFF
MDC 16 S2
OPTICAL ALIGN
SIGHT RH
DOCKING WINDOW
+Z
+Y
-Y
-Z
ORDEAL
AC 2
2A
MDC 8 CB65
$V_{AC\,2}$
ΦB
LIGHTING
BRT
OFF
ORDEAL DIM S6
LEB LIGHTS
FLOOD
OFF BRT
LEB 100 R1
FLOOD
DIM
2
LEB 100 S5
FLOOD
FIXED
OFF
LEB 100 S4
INTERIOR LIGHTS
FLOOD
OFF BRT
MDC 5 R1
INTERIOR LIGHTS
FLOOD
DIM
2
MDC 5 S10
INTERIOR LIGHTS
FLOOD
FIXED
OFF
MDC 5 S11
INTERIOR LIGHTS
FLOOD
OFF BRT
MDC 8 R1
FLOOD
DIM
2
MDC 8 S12
LIGHTING
FLOOD
MN A
15 A
RHEB 226 CB30
V_{MA}
MN B
15A
RHEB 226 CB31
V_{MB}
FLT/PL
5A
RHEB 226 CB38
V_{FP}
FLOOD
FIXED
OFF
POST LDG
MDC 8 S13


I
H
G
F
E
ORDEAL
DS1
AC NEUTRAL
FLOODLIGHT RH STRUT LEB
PRI
SEC
FLOODLIGHT LH STRUT LEB
SEC
PRI
FLOODLIGHT RH COUCH ARM
PRI
SEC
FLOODLIGHT RH INNER MOLD LINE
SEC
PRI
FLOODLIGHT LH COUCH ARM
PRI
SEC
FLOODLIGHT LH INNER MOLD LINE
SEC
PRI
INTERIOR LIGHTS
INTEGRAL
OFF
BRT
LIGHTING
NUMERICS INTEGRAL
LMDC - AC 1
2A
RHEB 226 CB37
VAC 1
ΦA
0 TO 115 VAC
MDC 8
T2
NUMERICS
MDC 8
T3
AC NEUTRAL
0 TO 115 VAC
0 TO 5 VAC
MDC 8
T4
MDC 15
MDC 9
MDC 7
NAV STA PANEL
FDAI A1
MDC 2
DSKY EL KEYS
G&N DISPLAY KEYBOARD MDC 2
DSKY C&S ANNUNCIATOR
DSKY NUMERICS PWR SUPPLY
MISSION TIMER
M20
MDC 2
EMS NUMERICS
A1
MDC 1
LEB LIGHTS
INTEGRAL
OFF
BRT
LIGHTING
NUMERICS INTEGRAL
LEB - AC 2
2A
RHEB 226 CB33
VAC 2
ΦA
0 TO 115 VAC
LEB 100
T2
NUMERICS
LEB 100
T3
AC NEUTRAL
0 TO 115 VAC
0 TO 5 VAC
LEB 100
T4
LEB 100
NAV COMM STA
RHEB 10
AUX CB PNL
RHEB 225
RH FWD CB PANEL
RHEB 226
LHFEB 306
DSKY EL KEYS
G&N DISPLAY KEYBOARD LEB 100
DSKY C&S ANNUNCIATOR
DSKY NUMERICS PWR SUPPLY
MISSION TIMER
M2
LHFEB 306
INTERIOR LIGHTS
INTEGRAL
OFF
BRT
LIGHTING
NUMERICS INTEGRAL
RMDC - AC 1
2A
RHEB 226 CB34
VAC 1
ΦB
0 TO 115 VAC
MDC 5
T2
AC 1 NEUTRAL
MDC 5
MDC 6
MDC 4
NAVIGATOR STA PANEL
MDC 2

LTR	DR	ENGR	DATE	APPROVAL



3. RECOVERY BEACON LIGHT SHOWN ON DWG 6.6

2 INCANDESCENT LIGHTS

NOTES: 1 FLUORESCENT LIGHT - CONVERTER IN EACH LIGHT FIXTURE CONVERTS +28 VDC TO AC

2 LIGHTING

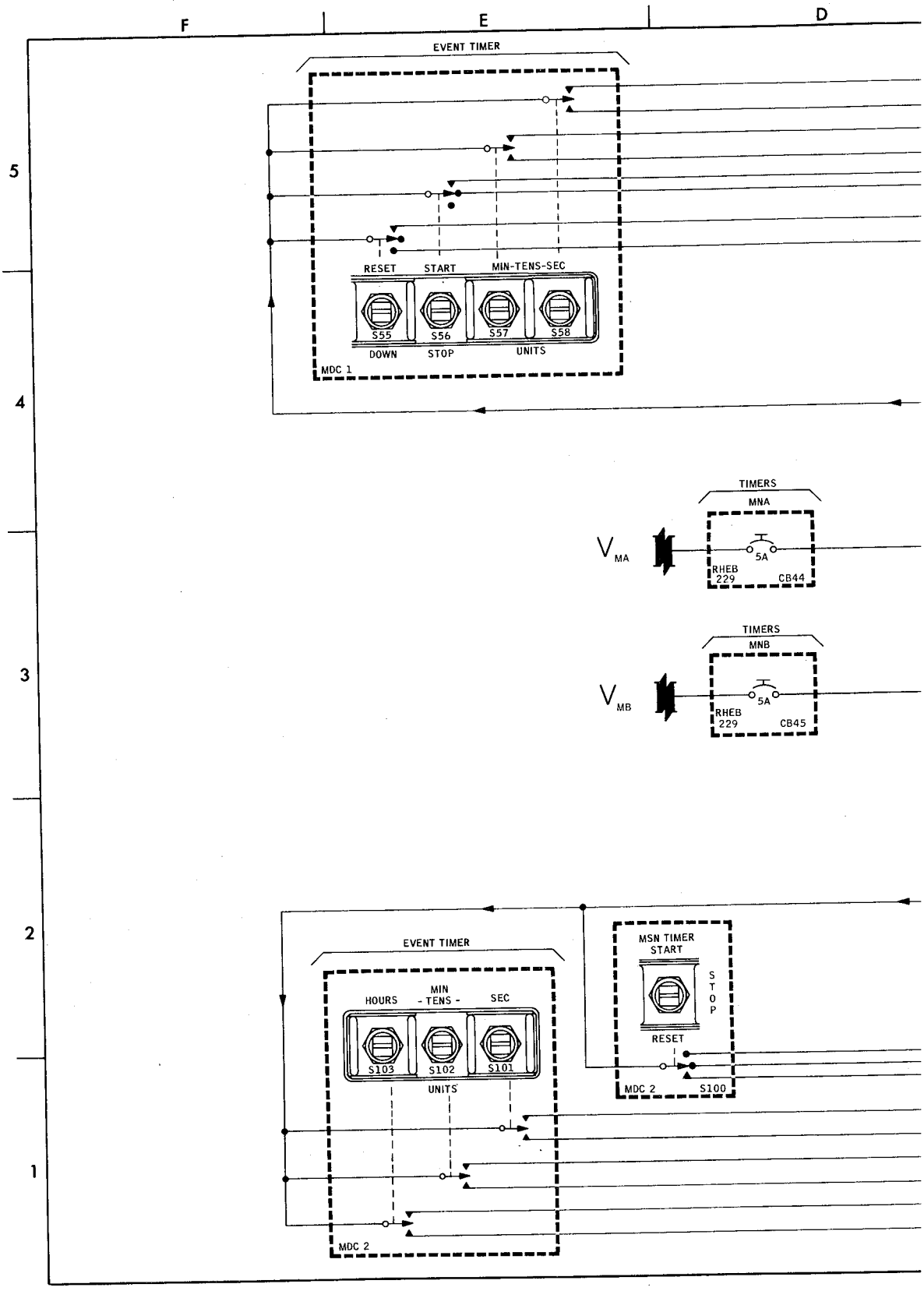
SIGNATURES	DATE
DR W. J. Bailey	
DSGN	
QC	11-6-68
ENGR C. M. Jones	11/1/68
NR	
APP	
FEC	
AUTH	11-7-68

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS

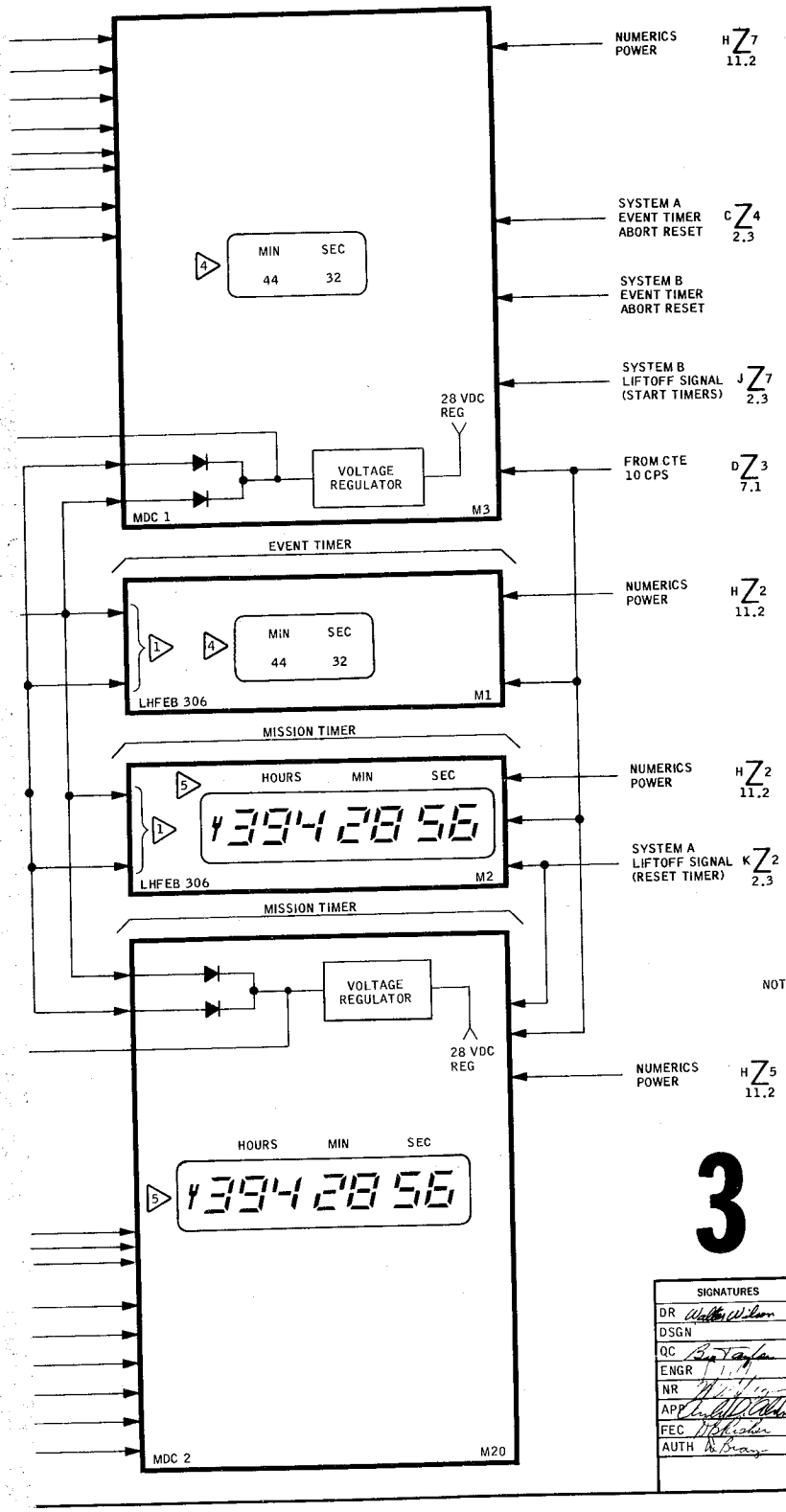
LIGHTING
INTERIOR AND EXTERIOR

CSM	SIZE	DWG NO.
104	J	11.2

99 X 34 PAGE SHEET 1 OF 1


F
E
D
5
4
3
2
1
EVENT TIMER
RESET
START
MIN-TENS-SEC
S55
S56
S57
S58
DOWN
STOP
UNITS
MDC 1
TIMERS
MNA
5A
RHEB
229
CB44
V_{MA}
TIMERS
MNB
5A
RHEB
229
CB45
V_{MB}
EVENT TIMER
HOURS
MIN
- TENS -
SEC
S103
S102
S101
UNITS
MDC 2
MSN TIMER
START
STOP
RESET
MDC 2
S100

LTR	ENGR		DATE	APPROVAL



NUMERICS POWER H Z7 11.2

SYSTEM A EVENT TIMER ABORT RESET C Z4 2.3

SYSTEM B EVENT TIMER ABORT RESET

SYSTEM B LIFTOFF SIGNAL (START TIMERS) J Z7 2.3

FROM CTE 10 CPS D Z3 7.1

NUMERICS POWER H Z2 11.2

NUMERICS POWER H Z2 11.2

SYSTEM A LIFTOFF SIGNAL (RESET TIMER) K Z2 2.3

NUMERICS POWER H Z5 11.2

5 MISSION TIMER WILL COUNT UP TO 999 59 59 ROLLOVER TO 000 00 00 AND START COUNTING UP

Ψ INDICATES THAT MISSION TIMER HAS SWITCHED TO AN INTERNAL TIMING PULSE RESULTING FROM A CTE EXTERNAL SIGNAL LOSS

4 EVENT TIMER WILL COUNT UP TO 59 59 ROLLOVER TO 00 00 AND START COUNTING UP

NOTES:

3. WHEN POWER IS FIRST APPLIED TO THE MISSION TIMER THE TIME MAY COME UP ON ANY SERIES OF NUMBERS
2. FOR PAD ABORTS, EVENT TIMER WILL RESET AND START COUNTING UP
1. SWITCH CONTROL FOR EVENT AND MISSION TIMER ON LHFEB 306 IS IDENTICAL TO THE SWITCH CONTROL FOR THE TIMERS ON MDC 2

3 TIMER

SIGNATURES	DATE
DR Walter Wilson	
DSGN	
QC Bob Taylor	9-5-68
ENGR	11/1
NR	11/1
APP	10/31/66
FEC	11/1/01
AUTH A. Bray	11-7-68

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MANNED SPACECRAFT CENTER • HOUSTON, TEXAS

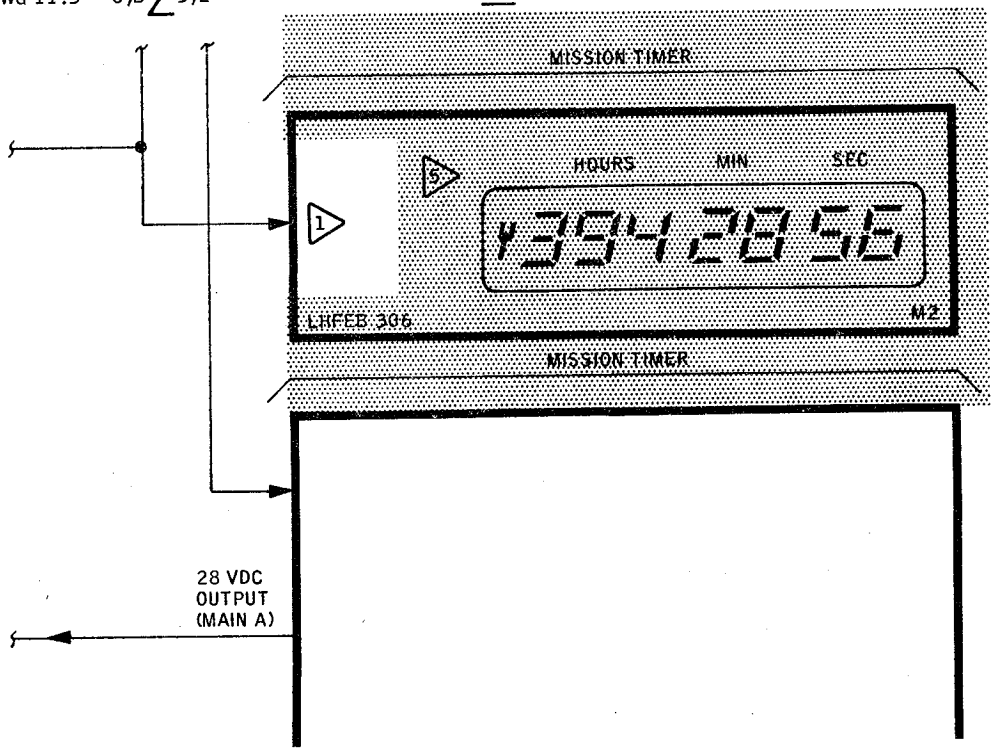
TIMER CONTROL

CSM	SIZE	DWG NO.
104	D	11.3
34 X 22		SHEET

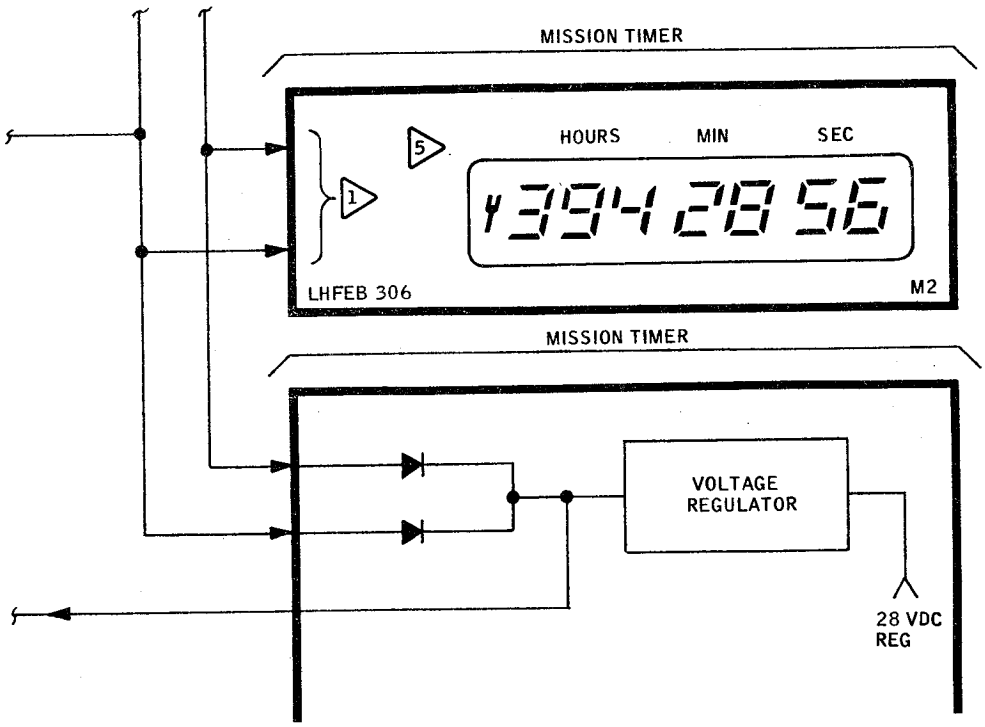
SECTION 11

1. DWG 11.3 C,B Z 3,2

IS



WAS



H G F E

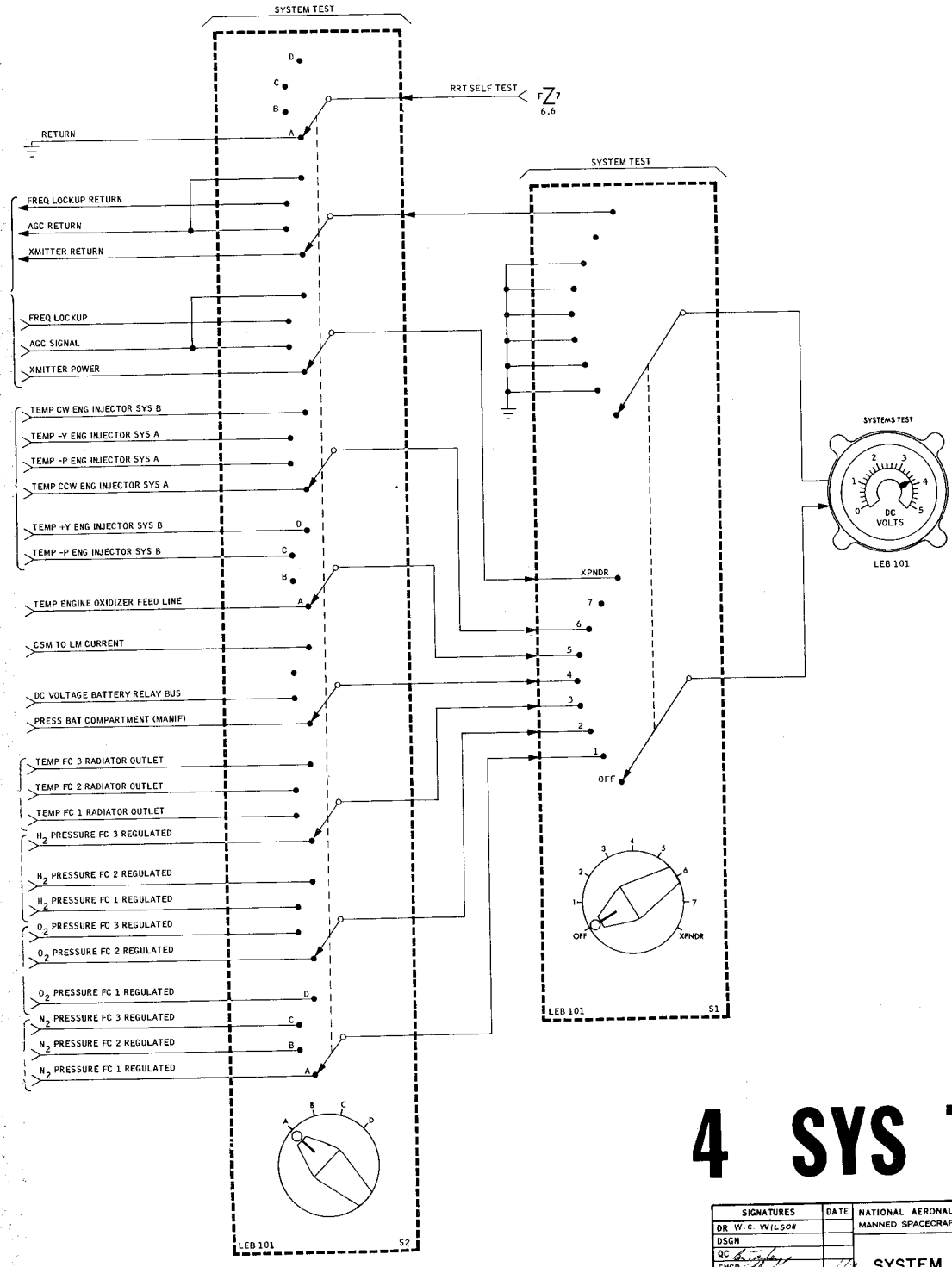
7 6 5 4 3 2 1

RENDEZVOUS RADAR TRANSPONDER

SYSTEMS TEST METER DISPLAY (VOLTS)

0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	
-50	-46	-42	-38	-34	-30	-26	-22	-18	-14	-10	-6	-4	0	+4	+10	+14	+18	+22	+26	+30	+34	+38	+42	+46	+50	CM-RCS OXIDIZER VALVE TEMPERATURE (°F)
0	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144	152	160	168	176	184	192	200	SPS TEMPERATURE (°F)
0	0.4	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.0	6.4	6.8	7.2	7.6	8.0	8.4	8.8	9.2	9.6	10.0	LM POWER (AMPS)
0	1.8	3.6	5.4	7.2	9.0	10.8	12.6	14.4	16.2	18.0	19.8	21.6	23.4	25.2	27.0	28.8	30.6	32.4	34.2	36.0	37.8	39.6	41.4	43.2	45.0	BATTERY RELAY BUS (VDC)
0.00	0.72	1.44	2.16	2.88	3.60	4.32	5.04	5.76	6.48	7.20	7.92	8.64	9.36	10.08	10.80	11.52	12.24	12.96	13.68	14.40	15.12	15.84	16.56	17.28	18.00	BATTERY MANIFOLD PRESSURE (PSIA)
-50	-36	-22	-8	+6	+20	+34	+48	+62	+76	+90	+104	+118	+132	+146	+160	+174	+188	+202	+216	+230	+244	+258	+272	+286	+300	EPS RADIATOR OUTLET TEMPERATURE (°F)
0	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63	66	69	72	75	N_2, O_2, H_2 PRESSURE (PSIA)
0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	

SYSTEMS TEST METER DISPLAY (VOLTS)



4 SYS TEST

SIGNATURES	DATE
DR W. C. WILSON	
DSGN	
QC	
ENGR	
NR	
APP	
FEC	
AUTH	

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS

SYSTEM TEST METER

CSM 104 | SIZE J | DWG NO. 11.4

44 X 29.75 | PAGE | SHEET OF